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No. 23-1922

In the
United States Court of Appeals
for the Federal Circuit

BEARBOX LLC, AUSTIN STORMS,

Plaintiffs-Appellants,

v.

LANCIUM LLC, MICHAEL T. McNAMARA, RAYMOND E. CLINE, JR.,

Defendants-Appellees.

Appeal from the United States District Court
for the District of Delaware, No. 1:21-cv-00534-GBW-CJB
The Honorable Gregory B. Williams

JOINT APPENDIX

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR., Defendants.	C.A. No. 21-534-GBW

Andrew C. Mayo, ASHBY & GEDDES, Wilmington, Delaware; Benjamin T. Horton, John R. Labbe, Raymond R. Ricordati III, Chelsea M. Murray, MARSHALL, GERSTEIN & BORUN LLP, Chicago, Illinois

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Counsel for Defendants

OPINION

March 6, 2023
Wilmington, Delaware

GREGORY B. WILLIAMS
UNITED STATES DISTRICT JUDGE

The Court held a three-day bench trial on the issue of correction of inventorship brought by Plaintiffs BearBox LLC and Austin Storms (collectively, "Plaintiffs" or "BearBox").[1] *See* D.I. 103. Plaintiffs alleged at trial that (1) Storms is the sole inventor of United States Patent No. 10,608,433 ("the '433 patent") and, thus, the '433 patent must be corrected to list Austin Storms as the sole inventor; or (2) alternatively, Storms is a joint inventor of some claimed subject matter of the '433 patent and, thus, the '433 patent must be corrected to list Austin Storms as a joint inventor. The parties have submitted post-trial briefing, *see, e.g.*, D.I. 256; D.I. 258; D.I. 260; D.I. 261, and proposed findings of fact, *see, e.g.*, D.I. 257; D.I. 259.

The Court has separately set forth its findings of fact and conclusion of law as required by Federal Rule of Civil Procedure 52(a)(1).

I. FINDINGS OF FACT[2]

A. The Parties

1) Plaintiff Austin Storms ("Storms") is the founder and sole employee of BearBox LLC. Tr. 106:22-107:2. Storms is a college graduate with a degree in geology and geographic information systems. Tr. 42:13-43:20; Tr. 110:10-12. Storms is currently employed by Galaxy Digital as the Vice President of Mining Operations, *see* Tr. 109:14-16, and has previously worked

[1] In response to the Operative Complaint, *see* D.I. 103, Defendants filed counterclaims for declaratory judgment that Austin Storms is not an inventor of the '433 patent (Count I) and declaratory judgment that BearBox has no ownership rights in the '433 patent (Count II). *See* D.I. 145. Defendants' declaratory judgment counterclaims rise and fall with Plaintiffs' claims of sole and joint inventorship.

[2] The Court's Findings of Fact are cited as "FF ¶ __."

for Great American Mining. Tr. 109:2-13. At the time this case was filed, Storms was a citizen of Louisiana. *See* D.I. 239-1, Ex. 1 at ¶ 2.

2) Plaintiff BearBox LLC ("BearBox") was founded by Storms in late 2018 to design and develop mobile cryptocurrency datacenters. Tr. 46:16-47:24; Tr. 106:22-107:2. BearBox is a Louisiana limited liability company with a principal place of business at 4422 Highway 22, Mandeville, Louisiana 70471. *See* D.I. 239-1, Ex. 1 at ¶ 1. BearBox has only ever sold one of its BearBox mobile cryptocurrency datacenter containers and did not turn a profit. Tr. 132:7-11. Today, BearBox manufactures no products, has one employee, i.e., Storms, and has no assets. Tr. 110:1-7.

3) Defendant Michael McNamara ("McNamara") is the Chief Executive Officer and co-founder of Lancium LLC. Tr. 532:25-533:3. McNamara is a resident of Newport Beach, California. *See* D.I. 239-1, Ex. 1 at ¶ 4; Tr. 532:23-24.

4) Defendant Raymond Cline, Jr. ("Cline") is a co-founder of Lancium LLC. Tr. 435:23-25. Cline has a B.S. degree in chemistry and a Ph.D. in chemical physics, *see* Tr. 432:6-7; Tr. 432:12-16, and has experience with computer programming and smart grid technology. Tr. 432:17-434:2. Cline personally mined the cryptocurrency "Bitcoin" between 2015 and 2017. Tr. 434:3-435:22. Cline is a resident of Houston, Texas. *See* D.I. 239-1, Ex. 1 at ¶ 5.

5) Defendant Lancium LLC ("Lancium") was founded in November 2017. Tr. 436:12-14; Tr. 533:4-5. Lancium is a Delaware limited liability company with its principal place of business at 6006 Thomas Road, Houston, Texas 77041. *See* D.I. 239-1, Ex. 1 at ¶ 3. Lancium's operations predominately stem from its Thomas Road R&D Facility in Houston, Texas. Tr. 448:24-450:3-21.

B. The Parties' Witnesses

1. Plaintiffs' Witnesses

a. Fact Witnesses

6) Austin Storms.

b. Expert Witnesses

7) Dr. Stanley McClellan ("Dr. McClellan") is a professor of electrical and computer engineering at the Ingrim School of Engineering, Texas State University. TX-19; Tr. 267:24-268:1. Dr. McClellan is an expert in distributed energy systems and smart grid technology. Tr. 271:7-274:24.

8) Frank McCamant ("McCamant") is an expert in electric utilities and ERCOT electricity markets. TX-983; Tr. 179:22-180:2. McCamant owns and operates McCamant Consulting, an Austin, Texas based firm that advises public and private entities on power development projects and the ERCOT market. Tr. 172:3-179:25.

2. Defendants' Witnesses

a. Fact Witnesses

9) Michael McNamara.

10) Raymond Cline, Jr.

11) Denis Labij ("Labij") is the current Vice President of Power Markets at GlidePath, and previously served as a GlidePath business development lead. Tr. 607:19-608:4. Labij was introduced to Storms through Benjamin Hakes, *see* Tr. 608:8-21, and discussed topics related to power markets with Storms. Tr. 608:14-622:5; TX-146.

12) Benjamin Hakes ("Hakes") was a project management consultant at GlidePath. Tr. 624:4-7. Hakes first contacted Storms through Twitter due to their mutual interest in Bitcoin. TX-

15; Tr. 624:11-625:3. Hakes and Storms have never met in person, but have communicated via email, text message, and phone calls. Tr. 625:8-626:13.

b. Expert Witnesses

13) Nikolaus Baer ("Baer") is an expert in software and source code development and analysis. Tr. 642:8-10. Baer holds a Bachelor of Science degree in computer engineering, has extensive experience in the computer code languages Python, C, C++, and JAVA, and is the founder of Baer Consulting, a firm which provides services for examining, analyzing, and developing software and source code. Tr. 638:7-642:7; TX-829.

14) Dr. Mark Ehsani ("Dr. Ehsani") is an expert in electrical engineering, including power control of datacenters and power markets. Tr. 678:12-15. Dr. Ehsani is currently the Robert M. Kennedy Professor of Electrical and Computer Engineering at Texas A&M University and is a distinguished lecturer at the Institute of Electrical and Electronics Engineers. Tr. 674:11-678:11; TX-831. Plaintiffs did not contest that, as related to the '433 patent, Dr. Ehsani is a person of ordinary skill in the art. Tr. 276:14-277:1.

C. The Invention at Issue

15) United States Patent No. 10,608,433 ("the '433 patent") is titled "Methods and Systems for Adjusting Power Consumption Based on a Fixed Duration Power Option Agreement," and was issued by the United States Patent and Trademark Office ("USPTO") on March 31, 2020. *See generally* '433 patent[3]; *see also* D.I. 239-1, Ex. 1 at ¶ 6. The '433 patent lists Michael McNamara and Raymond Cline, Jr. as the inventors. *See* '433 patent at Cover.

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[3] Although the '433 patent was admitted into evidence as TX-1, the Court will cite to the patent rather than the exhibit.

16) The '433 patent issued from United States Patent Application No. 16/702,931, which was filed on December 4, 2019. *See* D.I. 239-1, Ex. 1 at ¶ 7; *see* '433 patent at Cover. The '433 patent claims priority to United States Provisional Patent Application No. 62/927,119 ("the '119 Application"), which was filed on October 28, 2019. D.I. 239-1, Ex. 1 at ¶ 6; *see* '433 patent at Cover.

17) The '433 patent relates to a set of computing systems that are configured to perform computational operations using power from a power grid. *See* '433 patent at 5:48-49. The '433 patent also relates to a control system that monitors a set of conditions, receives power option data that is based, at least in part, on a power option agreement, which specifies minimum power thresholds associated with time intervals. *See id.* at 5:50-55. The set of computing systems may also determine a performance strategy for a load based on a combination of the power option data and one or more monitored conditions. *Id.* at 5:55-60. The performance strategy may specify a power consumption target for the load for each time interval such that each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. *Id.* at 5:60-6:13. More so, the computing systems may provide instructions the set of computing systems to perform one or more computational operations based on the performance strategy. *See id.* at 6:14-65.

18) The '433 patent has twenty (20) claims. *See* '433 patent at claims.

19) Plaintiffs contend, *see* D.I. 256 at 6, and Defendants do not dispute, *see* D.I. 258 at 9 n.4, that independent claims 1, 17, and 20 of the '433 patent contain substantially the same claim limitations, except that claims 17 and 20 do not require using power from a grid. *See* '433 patent at claim 17, 20. When discussing the independent claims of the '433 patent, rather than shift

between claims 1, 17, and 20, the Court will, unless otherwise indicated, substantively discuss only independent claim 1 of the '433 patent.

20) Claim 1 of the '433 patent reads:

> 1. A system comprising:
>
> [a] a set of computing systems, wherein the set of computing systems is configured to perform computational operations using power from a power grid;
>
> [b] a control system configured to:
>
> [b1] monitor a set of conditions;
>
> [b2] receive power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;
>
> [b3] responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and
>
> [b4] provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

See '433 patent at claim 1.

21) For ease of reference, the Court will follow the parties' practice at trial and throughout the post-trial briefing by referring to each element of claim 1 by the associated label above, *e.g.*, "[b1]," "[b2]," etc.

22) The parties do not dispute that a person of ordinary skill in the art ("POSA") is one who holds a degree in electrical engineering, computer science, or a similar field and has one to two years of experience in the field of software or an equivalent level of experience, or a bachelor's degree in electrical engineering, computer science, or a similar field, plus at least two years of experience designing and/or implementing power control systems for datacenters. Tr. 276:14-277:3.

D. Energy and ERCOT Markets[4]

23) The electrical grid is an interconnected system of generators, transmitters, and consumers that must be managed to ensure reliability. Tr. 180:8-25. A consumer of electricity is called a "load." Tr. 181:1-6. A manager of an electrical grid is called an "independent system operator," or "ISO." Tr. 181:15-25. ISOs manage the electrical grid by creating and managing energy markets to ensure a balance between supply and consumption (by the load) of power. A form of balance that ISOs utilize are called "ancillary services," which are a type of demand response that provide capacity reserves to ensure that the system capacity meets the system demand for electricity or power. Tr. 188:7-189:19, 206:7-10, 207:16-20.

24) The Electric Reliability Council of Texas ("ERCOT") is an ISO that operates a day-ahead energy market ("DAM") for buyers and sellers of energy that is voluntary, but financially binding. Tr. 202:8-11, 202:18-20. If a load buys energy in the DAM, it must pay for that energy, but it does not have to use that energy. Tr. 203:4-24. Instead, the load could sell that power in the real-time energy market ("RTM"), which is called "sell-back." Tr. 203:15-20, 203:25-204:13.

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[4] McCamant testified about the general nature and functionality of energy grids and the ERCOT market. Tr. 179:22-180:2. The Court finds this testimony credible and, therefore, relies on it.

25) ERCOT's energy markets are different markets than ERCOT's ancillary services market. Tr. 201:19-21. ERCOT's ancillary services market gives ERCOT the ability to decrease the amount of energy being used by participating loads. Tr. 207:4-7. A qualified scheduling entity ("QSE")—which is a required entity in the ancillary services market that acts as an intermediary between ERCOT and the load—submits an ancillary services offer and is granted an "award," which specifies minimum amounts of power the load has to use during specific time intervals during the operating day. Tr. 189:24-190:13; Tr. 192:6-11. Thereafter, the load is obligated to use, i.e., it cannot "sell-back," the amount of energy that is subject to the award, even if it is unprofitable to use the energy. Tr. 208:9-209:22; *see also* Tr. 207:25-208:8. A load that receives an ancillary services award is compensated by a "capacity payment," regardless of whether the load's power consumption is curtailed by ERCOT. Tr. 207:8-11, 209:23-210:9, 212:5-16; *see also* Tr. 190:14-24. ERCOT's ancillary services market has existed since early 2000. Tr. 194:1-3.

26) A controllable load resource ("CLR") is a participant in the ancillary services market and can submit ancillary services offers in incremental amounts of power. Thus, a CLR can incrementally reduce its power consumption rather than simply shutting the load completely off when curtailed by ERCOT. Tr. 194:9-198:24.

E. Timeline of the Parties' Relationship and Communications

1. Storms – Pre-FCAT Mining Summit

27) In 2017, Storms designed and built a half-megawatt datacenter for Bitcoin mining in his father's karate studio, but Storms' implementation was unprofitable due to the price of electricity. Tr. 43:21-46:6.

28) By late-2018, Storms began developing shipping containers that would house cryptocurrency miners, with the intention that such containers could be placed anywhere and be

controlled remotely. Tr. 47:14-52:4. Storms' development (the "BearBox System") led to the founding of BearBox LLC. Tr. 40:17-25; Tr. 47:3-13.

29) Through late-2018 into early 2019, Storms began to design, build, and test a system of relays, power distribution units ("PDUs"), and a computer user interface that allowed a remote user to control individual relays so that miners could be turned on and off. Tr. 46:52-52:13; *see, e.g.*, TX-128; TX-129; TX-130; TX-131; TX-132; TX-134; TX-138. Storms developed the BearBox System in his apartment and in the workshop of Jason Hutzler, an electrician and friend of Storms. Tr. 52:3-4; *see also* Tr. 48:24-49:10.

30) Around November 26, 2018, Storms met Benjamin Hakes, a representative at GlidePath, through Twitter. Tr. 56:12-58:8; TX-15 at 4. GlidePath is a wind asset and battery asset-generated developer, not a Bitcoin mining company. Tr. 58:1-8. Storms and Hakes began discussing how GlidePath could develop a system that mined cryptocurrency when electricity prices are low but sold wind energy to the grid when prices are favorable. Tr. 58:9-60:4. By December 10, 2018, Storms had signed a non-disclosure agreement with GlidePath. *See* TX-932.

31) On November 28, 2018, Hakes explained to Storms the concept of "behind the meter," TX-932 at 10001043, which means that the load is connected directly to a power generation entity, i.e., a wind farm, and transmits power to the load before transmitting power to the grid. Tr. 439:17-440:1. Between November 2018 and April 2019, Hakes also explained the meaning of locational margin price ("LMP"), power purchase agreement ("PPA"), and day-ahead price. *E.g.*, TX-14 at 21-22. LMP correlates to the price that a generator receives for selling power to the grid in a specific location, *see* TX-14 at 21, which Storms agreed is "shorthand" for the price of power. Tr. 60:23-61:4.

32) On April 5, 2019, Hakes wrote to Storms:

> It'll be super cool to write a little Python script that ran on the UPS at the mining site that looked at the LMP, locational marketing price, pricing at the wind farm feed and power on/off based on whether or not the LMP is above or below, so $0.03 per kilowatt hour.

See TX-14 at 21; Tr. 59:7-18, 60:23-61:4.

33) Storms then began to write source code for his BearBox system, *see* Tr. 52:14-24, and brainstormed the functionality of his source code on whiteboards ("Storms' Source Code"). *See, e.g.*, TX-20; TX-24; TX-32; TX-46; TX-47; TX-48; TX-49; TX-139; TX-140; TX-144.

34) On April 11, 2019, Storms wrote to Hakes:

> Let's talk some about the LMP check when you get a chance – I think I can model profitability of mining with LMP logic over a week or so vs. just selling @ LMP. If so, that's a game changer and we can develop it together to sell the system or full IP to the highest bidder. And realistically, the model will use on-site minding data with price API data to dynamically calculate what LMP selling power back to the grid is more profitable than mining. That's the real [arbitrage].

See TX-14 at 25.

35) Storms testified that he "wanted to talk to [Hakes] about the LMP check, because [he] thought that there was a way that [he] figured out [the profitability] of mining with the LMP logic over a week or so versus just selling power at the LMP. So you could dynamically compare the two and that realistically the model that [he] was working on at the time would use the onsite mining data and the Bitcoin price API data to calculate that profitability threshold or that LMP number." Tr. 60:9-17. Storms further testified that he believed this was "the real arbitrage opportunity," *see* Tr. 62:13, because "it would allow units of electricity to be sold at the most opportunistic price. This would be the arbitrage, that is the units of electricity price in the Bitcoin that they would mine in dollars versus being able to sell that back to the grid in dollars." Tr. 62:19-24.

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36) On April 19, 2019, Storms sent a text message to Hakes that included an annotated diagram titled "BearBox Automatic Miner Management System Version 1.0." TX-14 at 26-27. At trial, Storms explained that this annotated diagram illustrated his BearBox System, which embodied a scenario where the power entity would either use the generated power or sell that power to the grid at the real-time LMP price based on the price of power. Tr. 63:13-65:1; TX-14 at 27.

37) On April 23, 2019, Storms told Hakes that he "got the model running," and "[t]his is one of the coolest things I've ever put together FYI – thanks for the idea." TX-14 at 28. Storms explained to Hakes that his model compared "real time LMP vs. network hashrate profitability in 5 min increments." *Id.* At trial, Storms testified that the 5-minute intervals correlated to the frequency that the code would compare "mining versus what would be selling back power to the grid, if you were a generation asset owner." Tr. 67:3-11.

38) On April 24, 2019, Storms emailed Labij with questions related to energy markets, because Storms "didn't understand a few things about the market." TX-146; Tr. 72:8-73:8. At the time, Labij was "one of the power market guys at GlidePath." Tr. 72:13-14.

39) Labij responded on April 25, 2019, and described how Storms' Source Code could analyze profitability for Bitcoin mining. TX-962. Labij explained to Storms the need to calculate a Bitcoin breakeven price, how to calculate the revenue that could be earned by selling back power in the real-time market, and how to compare the profitability of mining Bitcoin to selling-back power in the real-time market. *See* TX-962; Tr. 610:8-619:10.

40) Storms responded on April 26, 2019, thanked Labij for his explanations, and stated that "it helps tremendously in my understanding of how these markets work. I was able to build a

workaround to the portal access issue and fetch both the day-ahead LMP data and the 5-minute RTBM LMP data." TX-149.

41) Storms' Source Code was completed by May 7, 2019. Tr. 67:19-68:21; Tr. 74:18-77:17. Neither party disputes that Storms' Source Code, including the whiteboard depictions, was never provided to Defendants. Tr. 115:18-22; Tr. 565:3-6; *see also* Tr. 418:21-419:3.

42) Both parties offered expert testimony related to the functionality and operation of Storms' Source Code. Plaintiffs' expert, Dr. McClellan, analyzed Storms' Source Code and concluded that, while never shown to Defendants, it corroborates that Storms conceived of each claim of the '433 patent. Tr. 281:8-307:8. Defendants' expert, Baer, analyzed Storms' Source Code and concluded that "the BearBox source code does not support the conception of the claims of the '433 patent." Tr. 642:13-18. Based on the experts' respective testimony and expert reports, the Court finds Baer's testimony related to the functionality and operation of Storms' Source Code to be more credible than Dr. McClellan's.

43) Baer testified that Storms' Source Code falls into three categories: (1) a user interface that would provide some manual control of a power distribution unit (PDU); (2) retrieving publicly available Bitcoin and power pricing data; and (3) simulations comparing profitability of mining Bitcoin versus selling power. Tr. 643:5-15.

44) The first category of Storms' source code is dated after May 3, 2019. Tr. 645:1-9. Baer testified that this category of Storms' Source Code allows a user to manually control the PDU relays attached to Bitcoin miners but is in no way associated with the other two categories of Storms' Source Code. Tr. 643:16-645:9. Storms acknowledged that this category of source code did not have anything to do with Storms' Data File, *see infra* Section I.E.4.c. *See* Tr. 157:18-158:7. Based on Storms' concession and Baer's credible testimony, the Court finds as a matter of

fact that the first category of Storms' Source Code did not relate to the subject matter claimed in the '433 patent.

45) The second category of Storms' Source Code comprises the files "DA_LMP_import.py," "DA_LMP_import_AEC.py," and "LMP_csv_import.py." *See* TX-20 at 25, 27; *see also* TX-49. Baer testified that this second category of Storms' Source Code retrieved publicly available information related to the price of Bitcoin and power. Tr. 645:10-646:24.

46) The third category of Storms' Source Code includes the files "denis_logic.py" (*see* TX-22; TX-20 at 13-19), "denis_logic_newgen.py" (*see* TX-20 at 4-10), "test_profit.py" (*see id.* at 29-32), "arb_main_AEC.py" (*see* TX-24), and "miner_amort_breakeven.py" (*see* TX-46). Baer credibly testified these source code files are simulations of the BearBox System that compare profitability of mining Bitcoin against selling power. *See, e.g.*, Tr. 647:2-4; Tr. 648:2-6, 655:15-656:2.

47) Baer further testified that the third category Storms' Source Code generally follows the same logic-steps: first, Storms' Source Code retrieves publicly available Bitcoin information; second, Storms' Source Code retrieves the day-ahead and real-time energy prices; third, Storms' Source Code calculates a breakeven mining cost; and fourth, Storms' Source Code compares the breakeven cost to the day-ahead and real-time energy prices. If either energy price is greater than or equal to the breakeven cost, Storms' Source Code sends signals to turn off all miners connected to the BearBox System. If energy price is less than the breakeven cost, Storms' Source Code sends signals to turn on all miners connected to the BearBox System. Tr. 647:5-653:23, 658:23-659:3; *see also* TX-22. Baer conceded that Storms' Diagram, *see infra* Section I.E.4.b, demonstrates the functionality of this category of Storms' Source Code. Tr. 671:10-672:1.

48) Baer also credibly testified that the third category of Storms' Source Code runs on a cycle, meaning that the simulation re-runs every five (5) minutes. Tr. 654:13-25. Re-running the simulation of Storms' BearBox System every five minutes is a fixed value within Storms' Source Code, is not received, and is not associated with an amount of power. Tr. 655:1-11; Tr. 666:10-19.

49) Further, Baer credibly testified that the only concept of power usage in Storms' Source Code is the value "kW_load." Tr. 660:3-662:16. However, Baer explained, and Storms agreed, *see* Tr. 146:23-147:6, that the "kW_load" value is a single, hard-coded value, meaning the only way to modify that value is to physically change the code—such as through the code's interpreter. Tr. 660:3-661:16, 665:12-666:9; *see also* Tr. 661:17-662:16. The "kW_load" value is not received by the BearBox System or Storms' Source Code, and both Baer and Dr. McClellan testified that the "kW_load" value is an estimate of the amount of power that the BearBox System uses, which includes a 5% "fudge factor," i.e., an overestimate of the amount of power the BearBox System uses. Tr. 665:12-666:9; *see also* Tr. 282:19-283:9, 294:22-295:6, 297:14-22; TX-24 at 1; Tr. 420:12-18, 424:5-11.

50) Baer also credibly testified that the files in the third category of Storms' Source Code are all substantially similar. Tr. 656:3-9. For example, the only differences between "denis_logic.py" and "arb_main_AEC.py" are different values for some variables, such as the hard-coded "kW_load" value, minor differences in how data is written to a spreadsheet similar to Storms' Data File, *see infra* Section I.E.4.c, and other minor differences that do not impact the logic or functionality. Tr. 656:10-658:22. Other files in this category, such as "test_profit.py," do not include all of the logic steps in "denis_logic.py." Tr. 658:23-659:18. None of the files that analyze whether to turn miners on or off by comparing the breakeven price of Bitcoin to the real-

time and day-ahead energy prices pre-date the "denis logic" files. *See, e.g.*, TX-20 at 1; TX-24 at 5; TX-46 at 5.

2. Lancium – Pre-FCAT Mining Summit

51) Lancium was formed in November 2017 with the intention of co-locating flexible data centers, such as Bitcoin miners, at windfarms to exploit the highly variable power output of windfarms. *See, e.g.*, Tr. 436:12-14; Tr. 437:11-438:16; Tr. 533:4-5; *see also* TX-373; TX-374 at 00025182; Tr. 541:21-542:15; TX-266 at 00020054. Lancium sought to "ramp down" its flexible datacenters to allow the wind farm to sell that power to the grid when energy prices were high, but when power prices were low, Lancium would "ramp up" its flexible datacenters. Tr. 438:10-439:16; TX-266 at 00020049; TX-374 at 00025182; Tr. 533:22-534:16; TX-372 at 00025166; Tr. 539:9-540:21, 541:5-20. Lancium's co-location was "behind-the-meter," and Lancium would agree to curtail its power usage based on real-time signals so that the windfarm could capture times when the price of power was high ("Lancium's Proposal"). Tr. 546:13-22.

52) By at least October 2018, Lancium performed analyses of how much more value windfarms would receive under Lancium's Proposal, *see, e.g.*, Tr. 546:17-547:2, 551:24-552:17; TX-176, including an analysis for GlidePath in November 2018. *See* TX-233; TX-234 at 00018300; TX-795; *see also* Tr. 547:15-548:1, Tr. 548:10-549:17; TX-478.

53) Around May 2018, Lancium became a market participant in ERCOT to enable Lancium to obtain data, such as power price data, that could allow it to make contemporaneous decisions on its energy usage. Tr. 544:6-545:7; *see also* TX-711; TX-712.

54) Lancium filed WO Patent Application No. 2019/139632 ("the '632 Application"), titled "Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources," which names both McNamara and Cline as inventors and has a priority date of

January 2018. TX-163 at Cover. Figure 6 of the '632 Application depicts the flexible data center (200) connected to the wind farm, as well as connections to the local power substation (690) and the grid (660). Tr. 441:13-442:7; TX-163 at Fig. 6; *see also* TX-163 at ¶¶ 53-54. Figure 2 of the '632 Application shows individual computing systems (100) of the flexible datacenter organized into racks and subsets (240), as well as a datacenter control system (220), which may be a computing system configured to "dynamically modulate power delivery to one or more computing systems (100)." Tr. 442:8-443:8; TX-163 at Fig. 2, ¶¶ 22, 30, 33, 38.

55) The '632 Application also describes that the flexible datacenter—based on an operational directive or via a determination based on monitored conditions, including economic conditions—would control its computing systems on a granular level, i.e., control on the individual computing system or collections of computing system level, to ensure that its systems consumed less power than the windfarm would generate. TX-163 at ¶¶ 22, 33, 44; Tr. 444:16-445:19. Thus, the flexible datacenter would monitor directives from the wind farm (and potentially the grid operator) indicating how much power the flexible datacenter could consume. TX-163 at ¶¶ 68, 90, Fig. 9; Tr. 445:2-446:10.

56) Cline credibly testified that, by the time the '632 Application was filed, Lancium monitored various conditions including receiving information on forecasts affecting the price of power and "economic considerations," such as the real-time price of power, the price of Bitcoin, and other information enabling Lancium to determine whether it was profitable to mine. Tr. 446:11-448:6; *see also* Tr. 542:16-544:5; TX-594 at 00033410; *see also* TX-163 at Figs. 4, 9, ¶¶ 42, 44, 68-72.

57) No later than October 2018, Lancium was operating one-hundred and twenty (120) cryptocurrency miners at its Thomas Road R&D Facility in Houston, Texas. Tr. 448:24-450:21;

TX-462, TX-463 at 00027993. To control its miners, Lancium modified off-the-shelf software from software companies ServiceNow and Tier44. Tr. 451:9-452:9. At its Thomas Road R&D Facility, Lancium's system was monitoring some of the information disclosed in the '632 Application, including power and Bitcoin price, to determine a performance strategy based on whether it was profitable to mine Bitcoin. Tr. 467:24-468:4. Based on such information and the information now available based on its status with ERCOT—including the network and global hashrate—, Lancium calculated the "breakeven price" for different types of miners, *see, e.g.*, Tr. 469:13-470:11; TX-222; TX-223, and used this calculation to determine when to turn miners on or off. *See, e.g.*, Tr. 470:12-471:1, 472:6-473:4, 477:18-20, 478:12-479:2 (citing TX-345 at 00024902). Calpine Energy Solutions ("Calpine") provided electricity for Lancium's Thomas Road R&D Facility, *see* Tr. 570:5-21, and Lancium maintained a "first power agreement" with Calpine until August 2019, meaning that Lancium paid the current market price for whatever power Lancium consumed. Tr. 574:7-12.

58) Lancium demonstrated its live system, including its 120 cryptocurrency miners, for an investor in September 2018. Tr. 459:16-461:14; TX-189 at 00015148-49; Tr. 464:14-465:4; TX-176 at 00014628-29; Tr. 465:5-468:4; TX-179; TX-180. At this time, Lancium also contemplated its system monitoring LMP, ERCOT parameters, and weather conditions, *see, e.g.*, Tr. 471:2-472:5; TX-222; TX-223, and controlling its systems remotely from its Network Operating Center, *see, e.g.*, Tr. 463:24-464:13; TX-176 at 00014629, or via a mobile computing device, *see, e.g.*, TX-163 at ¶¶ 29-30; TX-189 at 00015148-149.

59) On January 11, 2019, Lancium filed United States Patent Application No. 16/245,532 ("the '532 Application") titled "Redundant Flexible Data Workload Scheduling." TX-

165 at 00003135. The '532 Application lists McNamara and Cline as inventors. *Id.* at 00003137. Among other disclosures, the '532 Application disclosed:

> Some embodiments may involve identifying that a particular computational operation is a high priority operation. For instance, the enterprise funding the computational operation may emphasize the high priority status of the computational operation. In addition, the deadline for completing the computational operation may signal that the computational operation is high priority. As a result, a control system or another computing system may assign the high priority computational operation to multiple flexible datacenters. The assignment may specify for one or more flexible datacenters to initially support the computational operation and for one or more flexible datacenters to serve as a back-up in case of failure of the flexible datacenter(s) currently supporting the computational operation. The assignment of the computational operation may be based on power conditions and computational availability at the various flexible datacenters.

See TX-165 at ¶ 53.

60) Beginning in 2019, Lancium began to internally develop software as a primary platform for controlling its cryptocurrency miners. Tr. 477:18-478:11, 479:3-480:21; Tr. 481:12-482:16; TX-345 at 00024901. Around April 2019, Lancium investigated using an application program or interface to automatically retrieve LMP data directly from ERCOT. Tr. 480:22-481:11; TX-501. Cline credibly testified that, by May 1, 2019, Lancium's software was monitoring signals from a wind farm, ERCOT, Bitcoin price, real-time power price, hashrate, block height, and from the miners themselves—including the miners' actual power usage. Tr. 482:17-484:6; TX-320 at 00024330-32. Using that information, Lancium's software could determine a target power level that the miners should operate at and then send instructions to some or all of the miners to suspend or restart their hashing algorithms. Tr. 482:17-484:6; TX-320 at 00024330-32. Lancium's software eventually became known as "Lancium Smart Response," *see, e.g.*, Tr. 484:7-17; TX-320 at 0024330-31, and would operate by receiving the "Load Limit Setpoint," i.e., the maximum amount of power Lancium could use, and then determining whether

to use all, some, or none of that available power based on multiple variables or conditions. Tr. 484:18-487:7; TX-320 at 00024331-332. Lancium's Smart Response Software would also adjust to changes in the Load Limited Setpoint within an associated compliance period. *See* TX-320 at 00024333-34, Fig. 4-1.

61) Between 2018 and 2019, while Lancium was developing the software that became Lancium Smart Response, Lancium also worked with various companies to design and manufacture portable mining containers. Tr. 454:20-455:17; TX-371 at 00025037; Tr. 455:18-456:24, 457:7-17; *see also* TX-979. As of May 1, 2019, Lancium was considering purchasing forty (40) foot, two megawatt boxes holding approximately 1,428 cryptocurrency miners that met industry safety and security standards from manufacturer JV Driver/Ready Engineering, all for an estimated cost of approximately $230,000. Tr. 475:5-24; TX-781 at 00021534; Tr. 552:23-553:24.

62) By at least May 2, 2019, Lancium was considering whether it could apply its developed technology to grid applications when, at lunch with two cryptocurrency business developers—including Jamie McAvity—, McNamara learned that participating in demand response programs within ERCOT could effectively discount the price of power from the grid. Tr. 556:22-558:13, 559:3-15; *see also* TX-748.

3. FCAT Mining Summit

63) On May 3, 2019, Storms attended the FCAT Mining Summit in Boston, Massachusetts to learn more about the cryptocurrency industry, what others in the industry were doing, and to meet potential customers for his BearBox containers. Tr. 77:18-78:18; Tr. 110:21-111:7; TX-52 at 2. Prior to attending the FCAT Mining Summit, Storms sent a text message to Hakes explaining that Storms was "going to poke around and figure out if anybody else is doing

what we're doing." Tr. 118:5-8. Storms testified that "what we're doing" referred to his work with Hakes and GlidePath. Tr. 118:9-11.

64) During the FCAT Mining Summit, McNamara continued his discussion with Jamie McAvity about demand response programs within ERCOT. Tr. 559:19-560:2.

65) Both parties agree that, immediately following the FCAT Mining Summit, Storms met McNamara at a cocktail reception. Tr. 79:3-5. Before May 3, 2019, Storms had no knowledge of Lancium, and had never met or heard of McNamara. Tr. 116:13-17. Following the cocktail reception, a group of approximately eight people, including Storms and McNamara, went to dinner. Tr. 113:10-13; Tr. 216:12-14. Jon Cohen, the Chief Financial Officer of Lancium at the time, also attended this dinner, *see* Tr. 82:22-24, as well as Jamie McAvity. Tr. 113:10-114:12; Tr. 560:3-14.

66) The dinner lasted approximately two hours. Tr. 115:16-17. Storms sat across the table from McNamara. Tr. 115:7-15, 116:18-19. There is no dispute that Storms never showed McNamara or Jon Cohen any documents or source code at dinner. Tr. 115:18-116:4. Storms testified that he, McNamara, and Jon Cohen discussed the BearBox System, to which McNamara and Jon Cohen showed interest. Tr. 84:12-23. McNamara admits that Storms discussed his BearBox container, and that McNamara showed interest in its specifications and price. Tr. 563:3-12. McNamara and Storms did not discuss demand response programs or ancillary services. Tr. 562:25-563:2. Based on these facts, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms communicated the subject matter claimed in the '433 patent to McNamara, or anyone else employed by Lancium, during the May 3, 2019, dinner.

67) At dinner, Storms had at least two glasses of wine. Tr. 115:3-6. Following dinner, McNamara and Storms exchanged phone numbers. Tr. 84:24-85:2. Storms and McNamara never met again, and Storms never met or spoke to Cline or any other employee at Lancium. Tr. 116:8-12, 145:6-7. Ultimately, Storms never worked with Lancium. Tr. 144:25-145:7.

4. Storms' Email

68) On May 4, 2019, Storms contacted McNamara via text message. TX-742 at 00035256. The next day, Storms wrote: "I'll put some feelers out to some of my PM friends this week about what we talked about Fri night." *Id.* Neither party disputes that, at the time, Lancium was seeking product managers for their traditional computing business, and that Storms offered to contact possible product managers in his network. Tr. 92:5:12; Tr. 563:13-22.

69) On May 5, 2019, McNamara sent a text message to Storms stating: "I also think your boxes may have some benefits vs the ones we are doing with JB [sic] driver[.] Lots of stuff to collaborate on." TX-742 at 00035256. Storms responded: "Absolutely, I can send you specs on the boxes/PDUs/logic design – what's your email?" *Id.* McNamara then responded with his Lancium email address. *Id.*

70) On May 6, 2019, Storms sent a text message to Hakes, stating: "There are people doing what we're trying to do in ERCOT ISO in Texas. Met a few of big energy guys." TX-14 at 46; Tr. 118:13-20. A few minutes later, Storms sent Hakes a link to "Lancium.com," followed by a link to McNamara's LinkedIn profile. TX-14 at 46; Tr. 118:24-119:6. Minutes later, Storms sent another text message to Hakes, stating: "The guys at Lancium are doing what we are trying to do exactly, but they don't have a container builder or software team yet." TX-14 at 47; Tr. 119:7-14. Storms admits that he had no knowledge of what Lancium was doing with its software development. Tr. 121:14-25; TX-14 at 49.

71) Later that same day, Storms sent a text message to Hakes, stating: "And Michael McNamara wants me to bring some of my former product manager friends for his distributed computer service." TX-14 at 47; Tr. 119:23-120:6. Storms then wrote: "Plus they want my logic for curtailing miners on the DA and Real-Time LMP," and, "[a]ll over dinner Friday night and several bottles of wine, they told me they were looking into Digital Shovel." TX-14 at 48; Tr. 120:7-14. Both parties agree that Digital Shovel is a cryptocurrency container manufacturer, *see* Tr. 120:15-17, and that Lancium was concerned with the electrical hardware of Digital Shovel's containers and the potential liability stemming therefrom if Lancium were to purchase these containers. *See* Tr. 120:18-23; *see also* TX-14 at 48.

72) On May 8, 2019, McNamara sent a follow up text message to Storms, asking: "Storms, can you send me those box design specs please!" TX-742 at 00035257. Storms responded that he would later send over the specifications later that day, and then followed up with a text message to McNamara on May 9, 2019, stating: "Redoing one of the spec sheets for the newer Whatsminer models then emailing over to you." *Id.* Storms and McNamara did not communicate via text message after May 9, 2019. *Id.* Neither party disputes that Storms did not communicate any information related to the subject matter of the '433 patent through his text messages with McNamara. Tr. 126:20-22; Tr. 391:9-19. Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms communicated the subject matter claimed in the '433 patent to McNamara, or anyone else employed by Lancium, through Storms' text messages with McNamara.

73) On May 9, 2019, Storms sent a single email to McNamara ("Storms' Email"). TX-157 at 1. The subject line of Storms' Email reads: "BearBox 20' product details and supporting documents." *Id.* The body of Storms' Email reads:

Hey Michael,

See attached for the 20' BearBox product details and some supporting docs. I've also attached some recent modeling data from one of the Exelon wind sites (based on publicly available marketplace data) – I can model for any pricing node you guys might be interested in reviewing.

Let me know if you have any questions!

Talk soon,

A

Id.

74) Attached to Storms' Email were the following documents: (1) a one-page BearBox Product Specification Sheet ("BearBox Spec Sheet"), *see* TX-171; (2) an annotated diagram of BearBox's Automatic Miner Management System ("Storms' Diagram"), *see* TX-171; (3) specification sheets on fans and other hardware components, *see* TX-172 – TX-174; and (4) a data file modeling a simulation of the BearBox system ("Storms' Data File"), *see* TX-175. Storms agreed that McNamara did not ask for specifications on Storms' PDUs or logic design through their text message correspondence. Tr. 125:1-4. Storms and McNamara did not communicate following Storms' Email. Tr. 115:23-116:4; Tr. 565:3-6; *see also* Tr. 418:21-419:3. Storms admitted that nothing from the specification sheets on fans and other hardware components, *see* TX-172 – TX-174, related to the subject matter of the '433 patent. Tr. 128:9-129:8. Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that the specification sheets on fans and other hardware components attached to Storms' Email communicated the subject matter claimed in the '433 patent.

a. BearBox Spec Sheet

75) The BearBox Spec Sheet includes information related to BearBox's physical and electrical components, software management—including cgminer watchdog, PDU/relay mapping,

and optional real-time breakeven monitoring—, states that BearBox's containers could accommodate up to 272 Bitcoin miners, specifies different types of miners that could be used, and specifies that the maximum amount of power the BearBox container could accommodate was approximately 373kW. TX-171.

76) Storms admitted that the BearBox Spec Sheet does not indicate whether the BearBox System requires a certain amount of power to be used by the system, and similarly does not indicate that the system must use at least a specified amount of power for a specified period of time. Tr. 145:14-146:5. Storms also admitted that the BearBox Spec Sheet does not indicate that the BearBox System measured the actual amount of power the system used. Tr. 135:22-136:1.

b. Storms' Diagram

77) Storms' Diagram is titled "BearBox Automatic Miner Management System Version 1.0." TX-171 at 2. Storms' Diagram was not part of the BearBox Spec Sheet. Tr. 132:12-15.

78) Storms' Diagram illustrates a system wherein a BearBox container is connected to the electrical grid, depicted by a lightning bolt stemming from an illustration of six wind turbines. The lightning bolt is connected to a pipe, which immediately has a T-coupling. Off one end of the T-coupling, the electricity generated from the wind turbines transmits to the BearBox container. From the other end of the T-coupling, i.e., horizontally, stems two dotted lines, one labeled "Hourly," which is connected to a red bubble titled "Day-Ahead LMP for pricing node," and the other labeled "5-minute," which is connected to a red bubble titled "RTMB LMP for pricing node." *See* TX-171 at 2.

79) The parties dispute whether these two dotted lines represent the ability for the BearBox System to sell power back to the grid. *See* D.I. 256 at 7; D.I. 258 at 10-11. Baer credibly

testified that the second category of Storms' Source Code—the "DA_LMP_import.py," "DA_LMP_import_AEC.py," and "LMP_csv_import.py." files—retrieved publicly available information related to the price of Bitcoin and power, *see* Tr. 645:10-646:24, which supports that the dotted lines represent retrieving price of power information. *See* FF ¶ 45. Further, based on the parties' respective testimony, the Court finds Dr. Ehsani's testimony, *see* Tr. 681:19-684:23, regarding how a person of ordinary skill in the art would interpret Storms' Diagram to be more credible than either Dr. McClellan's or Storms' testimony, *see* Tr. 96:5-97:7; Tr. 168:21-169:4; Tr. 312:25-313:16. Based on these finding, the Court finds as a matter of fact that the two dotted lines represent the transmission of energy pricing information from the Day-Ahead Market and the Real-Time Market, not the ability of the BearBox System to sell electricity to the Day-Ahead Market or the Real-Time Market.

80) Storms admitted that Storms' Diagram does not indicate whether the BearBox System requires a certain amount of power to be used by the system, and similarly does not indicate that the system must use at least a specified amount of power for a specified period of time. Tr. 145:14-146:5. Storms also admitted that Storms' Diagram does not indicate that the BearBox System measured the actual amount of power the system used. Tr. 135:22-136:1.

c. Storms' Data File

81) Storms' Data File is a spreadsheet that represents a simulation of whether to mine Bitcoin or sell the power back to the grid. Tr. 140:13-16. The decision to mine or not mine was made by the load. Tr. 149:10-150:21.

82) Storms admitted that Storms' Data File does not indicate whether the BearBox System requires a certain amount of power to be used by the system, and similarly does not indicate that the system must use at least a specified amount of power for a specified period of time. Tr.

145:14-146:5. Storms also admitted that the information in columns A-B, D-E, G, and I-J is publicly available data. Tr. 137:4-24; TX-887 at 1.

83) Further, Storms admitted that, based on Storms' Data File, a person could not tell how much power a load consumed in each 5-minute interval "unless you know how it's calculated." Tr. 168:3-8. Storms also sent a similar spreadsheet to a separate individual, who then asked: "what do you factor into the 'breakeven_mining_cost'?" TX-919 at 909; TX-920; Tr. 151:10-17. Storms responded by sending portions of his source code. Tr. 151:23-152:2; TX-919 at 908.

5. After The FCAT Mining Summit

84) The Court finds McNamara's testimony related to his receipt of Storms' Email credible. McNamara testified that, upon receipt of Storms' Email, he spent no more than three minutes reviewing the attachments. Tr. 567:9-23; TX-770. McNamara also credibly testified that he considered the price of the BearBox System to be too high compared to other container manufacturers Lancium solicited, *see* Tr. 565:11-22, but forwarded Storms' Email, including all of the attachments, to other Lancium executives, including Cline. TX-770. In forwarding Storms' Email to Cline, McNamara wrote that he considered the BearBox System to be "very expensive," but did not comment on any of the attachments. TX-770.

85) The Court also credits Cline's testimony that, upon receiving the forwarded Storms' Email, Cline reviewed the BearBox Spec Sheet and believed the BearBox System was expensive, small, and lacking industry safety features when compared to the box JV Driver was designing and manufacturing for Lancium. Tr. 488:17-491:5; *see also* FF ¶ 60. Cline also testified that he did not recall whether he opened Storms' Data File, *see* Tr. 518:4-12, but metadata shows that Cline did download Storms' Data File on May 9, 2019. TX-984.

86) McNamara and Cline both testified that they were not aware of any internal discussions within Lancium regarding Storms, Storms' Email, or its attachments, after May 9, 2019, until this lawsuit was filed. Tr. 491:22-25; Tr. 568:2-3. Plaintiffs failed to proffer any conflicting evidence. Tr. 393:20-23. Accordingly, the Court credits this testimony from McNamara and Cline.

87) Following the FCAT Mining Summit, McNamara continued his discussions with Jamie McAvity, *see* Tr. 569:3-10; TX-748 – TX-750. On May 10, 2019, Jon Cohen contacted Calpine, asking whether it had "any intro material on participating in EROT's [sic] [Emergency Response Service] program? We think [our] load is well suited, but were curious as to what the process and requirements are." Tr. 570:5-21; TX-626 at 00033800. Calpine then introduced Lancium to Jay Young—a consultant with expertise on ERCOT's Demand Response programs—who, on May 18, 2019, forwarded a slide deck explaining the function of QSEs in ERCOT's Demand Response Program. Tr. 570:21-571:24; *see also* TX-437; TX-438 at 00026309-311; Tr. 571:25-572:11; TX-740; TX-741. Through Jay Young, Lancium was introduced to MP2, which became Lancium's QSE when Lancium qualified as a "load resource" with ERCOT. Tr. 572:11-573:18; TX-496; TX-497 at 00030580.

88) On August 5, 2019, Calpine responded to an inquiry from Lancium regarding a fixed price power agreement given "how close we are to all time historical lows" for the price of power. Tr. 573:21-574:21; TX-758; TX-122. Calpine projected that Lancium could reduce its power price by $10 per MWh. Tr. 574:13-575:4; TX--763; TX764; *see also* Tr. 575:12-25. Based on this projection, on August 14, 2019, Lancium entered into a fixed price power addendum with Calpine. Tr. 576:1-3; TX-756; TX-757. Section 4.2.2 of this 2019 addendum contained a standard, non-negotiated sell-back provision, *see* Tr. 576:8-17; TX-757, which is the same

provision contained in Lancium's 2018 "first power agreement," *see* Tr. 576:18-577:6; TX-122 at 00035638; *see also* FF at ¶ 57.

89) McNamara testified that Lancium had not appreciated its ability to sell-back power until it entered into the 2019 fixed price power addendum with Calpine because Lancium was not pre-purchasing power and, thus, could not sell it back. *See, e.g.*, Tr. 577:7-13; Tr. 566:20-25, 577:10-15, 578:2-5, 578:23-579:5; *see also* FF at ¶ 57. On August 16, 2019, McNamara emailed Cline, explaining that Lancium had just entered into a fixed price power agreement with Calpine, and further stating: "This is cool. We now have two revenue sources: Bitcoin mining and selling power back to the grid." TX-567. The Court finds McNamara's testimony related to how Lancium learned of its ability to sell-back power credible and, thus, relies on it.

90) On August 26, 2019, Lancium received an "award" under ERCOT's Load Resource Ancillary Services Program, which specifies an "award" in megawatts for each 1-hour interval in a 24-hour period. TX-981; TX-982; Tr. 492:15-494:5. Cline credibly testified that, upon receiving this "award," he realized that "the award is essentially an obligation on [Lancium's] part, that we consume that amount of power that ERCOT COULD curtail." TX-526; Tr. 494:17-496:14.

91) Cline credibly testified that this led to his understanding that Lancium was obligated to consume the awarded power so that ERCOT could exercise its option to curtail Lancium's power consumption. Tr. 496:8-25; TX-526; TX-310. Cline also credibly testified that this led Lancium to develop strategies to ensure that its system used at least the awarded amount of power. Tr. 497:1-499:5; TX-526; TX-310; *see also* TX-595. By October 2019, Lancium was investigating its ability to qualify as a CLR, rather than simply a load resource, based on Lancium's Smart Response Software, and in June 2020, Lancium became the first load-only CLR within ERCOT. *See* TX-298; Tr. 499:21-501:3.

92) On October 28, 2019, Lancium filed the '119 Application, which ultimately issued as the '433 patent. D.I. 239-1, Ex. 1 at ¶ 6; *see* '433 patent at Cover.

F. Conception of the Elements of the '433 Patent

1. Independent Claims

a. Preamble [a], Elements [b] and [b1]

93) The parties do not dispute that Storms' Email meets preamble [a] and elements [b] and [b1] of claim 1 of the '433 patent. *See* D.I. 256 at 5-6; D.I. 258 at 9-10. Additionally, the parties do not dispute that Storms' Email meets preamble [a] and elements [b] and [b1] of claims 17 and 20 of the '433 patent. *Id.*

94) However, Defendants dispute whether Storms' Email amounts to no more than a communication regarding what was already known in the art and, thus, cannot establish that Storms communicated preamble [a] and element [b] of claims 1, 17, and 20 of the '433 patent prior to Defendants' conception. D.I. 258 at 9. Specifically, Defendants assert that Lancium's '632 Application disclosed "flexible data centers consisting of a set of computing systems (computers) configured to perform computational operations (e.g., mining Bitcoin) using electrical power, including from the grid," prior to receiving Storms' Email. *Id.* Further, Defendants contend that, prior to receiving Storms' Email, Lancium's Thomas Road R&D Facility had already reduced to practice a system that was grid connected and using computer systems to mine Bitcoin. *Id.*

95) The Court finds as a matter of fact that Defendants had independently conceived of, and reduced to practice, preamble [a] and element [b] of claims 1, 17, and 20 of the '433 patent no later than January 2018. *See* FF at ¶¶ 51-62. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms

communicated preamble [a] and element [b] of claims 1, 17, and 20 of the '433 patent prior to Defendants' conception.

96) Additionally, the parties dispute whether Storms' Email corroborates communication of element [b1] of the '433 patent prior to Lancium's independent conception. D.I. 256 at 17-18; D.I. 258 at 17. In other words, did Lancium conceive of element [b1] prior to receiving Storms' Email on May 9, 2019.

97) The Court finds as a matter of fact that Lancium independently conceived of element [b1] of the '433 patent prior to Storms' Email for three reasons. First, by at least January 2018, Lancium's system was monitoring conditions, including economic conditions, to control its computing systems on a granular level—as disclosed in the '632 Application. *See* FF at ¶¶ 54-55. Second, Cline credibly testified that, by the time the '632 Application was filed, Lancium monitored various conditions including receiving information on forecasts affecting the price of power and "economic considerations," such as the real-time price of power, the price of Bitcoin, and other information. *See* FF at ¶ 56. Third, Cline credibly testified that, by no later than October 2018, Lancium's system at its Thomas Road R&D Facility was monitoring conditions including power price, Bitcoin price, network and global hashrate, LMP, ERCOT parameters, and weather conditions to determine a performance strategy based on whether it was profitable to mine Bitcoin. *See* FF at ¶¶ 57-58.

98) Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms communicated element [b1] of the '433 patent prior to Defendants' independent conception.

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b. Element [b2]

99) The parties dispute whether Storms' Diagram, the BearBox Spec Sheet, or Storms' Data File meets element [b2] of claim 1 of the '433 patent. D.I. 256 at 7-10; D.I. 258 at 10-12. The Court has previously construed "power option agreement" to mean "an agreement between a power entity associated with the delivery of power to a load and the load, wherein the load provides the power entity with the option to reduce the amount of power delivered to the load up to an agreed amount of power during an agreed upon time interval such that the load must use at least the amount of power subject to the option during the time interval unless the power entity exercises the option." *See* D.I. 219.

100) Plaintiffs contend that the lightning bolt between the six wind turbines and the pipe connected to the BearBox container, as depicted in Storms' Diagram, *see* TX-171 at 2, meets element [b2] of claim 1 of the '433 patent. Specifically, Plaintiffs argue Storms' Diagram meets element [b2] because "[t]he contractual arrangement between the load and the generator could vary, but the presence of the connection between the two implies that they have agreed on a contractual arrangement defining how power would be delivered, at what price, and the like." D.I. 256 at 7-8. Based on Storms' Diagram, Plaintiffs conclude that "the windfarm has the option of selling to the grid or providing power to the load to consumer for Bitcoin mining." D.I. 256 at 7. Neither party disputes that the six wind turbines are "a power entity associated with the delivery of power," and that the BearBox container is "a load."

101) The Court finds as a matter of fact that Storms' Diagram does not meet element [b2] of claim 1 of the '433 patent for three reasons. First, the Court has already found as a factual matter that the two dotted lines represent the transmission of energy pricing information from the Day-Ahead Market and the Real-Time Market, not the ability of the power entity to sell electricity

to the Day-Ahead Market or the Real-Time Market. *See* FF at ¶ 79. Second, there is no indication that a power option agreement, as construed by the Court, exists between the power entity and the load. In fact, Storms admitted that Storms' Diagram (i) does not indicate whether the BearBox System requires a certain amount of power to be used by the system, (ii) does not indicate that the BearBox System must use at least a specified amount of power for a specified period of time, and (iii) does not indicate that the BearBox System measured the actual amount of power the system used. *See* FF at ¶ 80. Third, the Court finds that Dr. McClellan's testimony related to the BearBox System operating under a power option agreement, or that a person of ordinary skill in the art would have understood this relationship, was not credible based on multiple inconsistencies between Dr. McClellan's expert reports, deposition testimony, and trial testimony. *See, e.g.*, Tr. 266:18-267:4; D.I. 247 at 3; Tr. 334:3-5; Tr. 398:13-401:23, 403:10-404:9, 404:15-406:19, 408:11-414:25.

102) The parties also dispute whether the BearBox Spec Sheet meets element [b2] of claim 1 of the '433 patent. Plaintiffs contend that the BearBox Spec Sheet corroborates that Storms conceived of the BearBox System that was connected to a power generation facility, that the BearBox System had ability of the system to mine Bitcoin or not mine Bitcoin, and that the BearBox System could mine Bitcoin at a particular target. *See* D.I. 257 at ¶ 30 (citing Tr. 312:3-7; Tr. 322:4-327:14; TX-157).

103) The Court finds as a matter of fact that the BearBox Spec Sheet does not meet element [b2] of claim 1 of the '433 patent for two reasons. First, the BearBox Spec Sheet only discloses information related to the BearBox System's physical hardware components and software management. *See* FF at ¶ 75. Second, the BearBox Spec Sheet has no indication that a power option agreement, as construed by the Court, exists between the power entity and the load.

In fact, Storms admitted that the BearBox Spec Sheet (i) does not indicate whether the BearBox System requires a certain amount of power to be used by the system, (ii) does not indicate that the BearBox System must use at least a specified amount of power for a specified period of time, and (iii) does not indicate that the BearBox System measured the actual amount of power the system used. *See* FF at ¶ 76.

104) Additionally, the parties also dispute whether Storms' Data File meets element [b2] of claim 1 of the '433 patent. The Court has previously construed "minimum power threshold" to mean "a minimum amount of power a load must use during an associated time interval." *See* D.I. 219. Plaintiffs contend that Storms' Data File corroborates conception of element [b2] because it shows 5-minute intervals over which the BearBox System functions, describes the mining revenue indicating power utilization at about 31 kW during an associated 5-minute interval, and describes the sell-back revenue indicating a reduction in power usage in the full amount for that 5-minute interval. *See* D.I. 257 at ¶ 26 (citing Tr. 309:12-13, 311:17-21, 313:21-22, 316:10-15, 317:4-8, 323:10-324:24; TX-157). Furthermore, Plaintiffs contend that Storms' Data File is an illustration of the functionality of Storms' Source Code, which corroborates Storms' conception of element [b2] of claim 1 of the '433 patent. *See* D.I. 257 at ¶¶ 27, 32.

105) The Court finds as a matter of fact that Storms' Data File does not meet element [b2] of claim 1 of the '433 patent for four reasons. First, there is no indication that a power option agreement, as construed by the Court, exists between the power entity and the load. In fact, Storms admitted that the Storms' Data File does not indicate whether the BearBox System requires a certain amount of power to be used by the system and does not indicate that the BearBox System must use at least a specified amount of power for a specified period of time. *See* FF at ¶ 82. Second, Baer credibly testified that the 5-minute interval in Storms' Source Code functions to "re-

run" the simulation every 5 minutes, but that value is fixed within the code, is not received, and is not associated with an amount of power. *See* FF at ¶ 48. Third, the "kW_load" value in Storms' Source Code does not represent the required amount of power that a load must use, i.e., a "minimum power threshold," but rather represents an estimation of the power usage of the miners with a 5% "fudge factor." *See* FF at ¶ 49. Fourth, Storms conceded that Storms' Data File was not concerned with maintaining the load above a certain power level because the intent of the BearBox System was that the load would run at 100% if it was profitable to mine and 0% if it was more profitable to sell power back. Tr. 148:25-149:5; *see also* Tr. 149:6-9.

106) Based on these findings, the Court finds as a matter of fact that Plaintiffs did not establish by clear and convincing evidence that Storms conceived of element [b2] of claim 1 of the '433 patent.

c. Element [b3]

107) The parties dispute whether Storms' Email, specifically Storms' Data File, meets element [b3] of claim 1 of the '433 patent. *See* D.I. 256 at 11-12; D.I. 258 at 12-13.

108) Plaintiffs contend that Storms' Data File meets element [b3] of claim 1 of the '433 patent because it "describes the operation of Storms' source code, showing for each of eight-hundred twenty-five (825) 5-minute intervals, that the system monitored conditions, determined a performance strategy using breakeven and revenue generation calculations, and instructed miners to utilize energy to mine or instructed the miners to stop mining when curtailment was required." D.I. 256 at 11 (citing D.I. 257 at ¶ 32). In other words, Plaintiffs assert that Storms' Data File corroborates that Storms conceived of a system that would continuously mine Bitcoin except for the limited instances when the miners were instructed to stop consuming power, which was determined for every 5-minute interval. *Id.* Further, Plaintiffs argue that Storms' Diagram also

shows these alternating periods of mining (shown with Bitcoin symbols) and curtailment/sellback activities (shown with dollar signs). D.I. 256 at 11-12; *see* TX-171 at 2.

109) The Court finds as a matter of fact that neither Storms' Data File or Storms' Diagram meet element [b3] of claim 1 of the '433 patent for six reasons. First, Plaintiffs' reliance on Storms' Data File as corroborating the functionality of Storms' Source Code is belied by the fact that Plaintiffs' own expert, Dr. McClellan, testified that Storms' Data File provides "information upon which to embark on a reverse engineering exercise of what Mr. Storms' system did," *see* Tr. 374:21-375:12, but that such a reverse engineering exercise "would be fraught with trial and error," *see* Tr. 397:11-16. Second, Storms admitted that, based on Storms' Data File, a person could not tell how much power a load consumed in each 5-minute interval "unless you know how it's calculated." *See* FF at ¶ 83; Tr. 168:3-8. However, there is no dispute that Storms' Source Code was never provided to Defendants. *See* FF at ¶ 41. Third, Baer credibly testified that the 5-minute interval in Storms' Source Code functions to "re-run" the simulation every 5 minutes, but that value is fixed within the code, is not received, and is not associated with an amount of power. *See* FF at ¶ 48. Fourth, Storms' Data File does not demonstrate that, responsive to receiving power option data, the BearBox System determines a power consumption target that is equal or greater than the minimum power threshold associated with each time interval because, as a matter of fact, Storms' Data File simulated whether to mine or not mine based on a comparison of the price of power versus the price of Bitcoin. *See* FF at ¶¶ 46-47. And, while Baer testified that Storms' Diagram illustrated the functionality of Storms' Source Code, *see* Tr. 671:10-672:1, there is no evidence establishing that Storms' Diagram determines a power consumption target that is equal or greater than the minimum power threshold associated with each time interval. In fact, Storms admitted that Storms' Diagram does not indicate that the BearBox System must use

at least a specified amount of power for a specified period of time. *See* FF at ¶ 80. Fifth, any assertion that Storms' Data File corroborates that the BearBox System determined a power consumption target that is equal to or greater than the minimum power threshold associated with each time interval is belied by Storms' admission that the "kW_load" value is hard-coded, meaning the only way to modify that value is to physically change the code. Tr. 146:23-147:6; *see also* Tr. 665:12-666:9; *see* FF at ¶ 49. In fact, the "kW_load" value is not received by the BearBox System or Storms' Source Code. *See* FF at ¶ 49. Sixth, Storms conceded that Storms' Data File was not concerned with maintaining the load above a certain power level because the intent of the BearBox System was that the load would run at 100% if it was profitable to mine and 0% if it was more profitable to sell power back, *see* Tr. 148:25-149:5; *see also* Tr. 149:6-9, which belies any assertion that the BearBox System could determine a power consumption target equal to or greater than the minimum power threshold.

110) Accordingly, the Court finds as a matter of fact that Plaintiffs did not establish by clear and convincing evidence that Storms conceived of element [b3] of claim 1 of the '433 patent.

d. Element [b4]

111) The parties dispute whether Storms' Diagram, the BearBox Spec Sheet, or Storms' Data File meets element [b4] of claim 1 of the '433 patent. *See* D.I. 256 at 12; D.I. 258 at 13; *see also* D.I. 257 at ¶¶ 36-37.

112) Plaintiffs contend that Storms' Diagram, the BearBox Spec Sheet, and Storms' Data File all corroborate that Storms conceived of element [b4] of claim 1 of the '433 patent because each describe "control systems' remotely controllable PDU, which enabled fine-grain load control of the systems 272 miners of varying types." D.I. 256 at 12 (citing D.I. 257 at ¶ 37). In one example, Plaintiffs assert that "each miner consumed about 1.3 kW per hour, for a maximum

amount of power consumption of about 373kw per hour, or about 31 kW per 5-minute interval (about .1 kW per miner)." *Id.* Plaintiffs further aver that Storms' Data File describes "the 5-minute intervals over which the system functions, describing mining revenue indicating power utilization at about 31 kW during an associated 5-minute interval and the sell-back revenue indicating a reduction in power usage in the full amount for that 5-minute interval." D.I. 257 at ¶ 37 (citing Tr. 309:12-13; Tr. 311:17-21; Tr. 313:21-22; Tr. 316:10-15; Tr. 317:4-8; Tr. 323:10-324:24).

113) The Court finds as a matter of fact that Storms' Email does not meet element [b4] of claim 1 of the '433 patent for two reasons. First, while both the BearBox Spec Sheet and Storms' Diagram describe the BearBox System as capable of custom remote control of the PDUs, Plaintiffs did not otherwise proffer evidence establishing that the BearBox System could individually control the system of 272 miners. TX-171. In fact, as Baer credibly testified, the first category of Storms' Source Code allows users to manually control the PDU relays attached to Bitcoin miners, but there is no indication that the BearBox System could remotely control individual miners. Tr. 643:16-645:9; *see* FF at ¶ 44. Rather, Storms' Source Code "only ever instructs . . . all the relays of the PDUs to turn on or off." *See* Tr. 662:18-664:10. Although Dr. McClellan testified that Storms' Source Code had the functionality to turn individual miners on or off, *see* Tr. 280:10-281:2, 295:4-296:2, the Court finds Baer's testimony more credible and, thus, does not rely on Dr. McClellan's testimony. Second, even if Storms' Email did meet element [b4] of claim 1 of the '433 patent, the Court finds as a matter of fact that Storms did not communicate element [b4] prior to Defendants' independent conception. As disclosed in the '632 Application filed in January 2018, Defendants had conceived of a system where a set of computer systems issued instructions to perform computational operations based on a performance strategy derived

from monitored conditions, *see* FF at ¶¶ 54-56, and reduced the system to practice by October 2018. *See* FF at ¶¶ 57-58.

114) Accordingly, the Court finds as a matter of fact that Plaintiffs did not establish by clear and convincing evidence that Storms conceived of element [b4] of claim 1 of the '433 patent.

1. Dependent Claims

a. Claims 2, 3, and 5

115) The parties dispute whether Storms' Email corroborates that Storms conceived of and communicated the subject matter of dependent claims 2, 3, and 5 of the '433 patent to Defendants prior to Defendants' independent conception. *See* D.I. 256 at 12-13; D.I. 258 at 13-14. Specifically, Plaintiffs assert that "[a]s explained above with respect to claim 1, Storms' system monitored real-time and day-ahead power prices and various parameters associated with Bitcoin mining computational operations[,]" which is corroborated by Storms' Diagram, Storms' Data File, and Storms' Source Code. D.I. 256 at 12-13.

116) Claim 2 depends from claim 1 and adds specific monitored conditions, i.e., the "price of power from the power grid" and "a plurality of parameters associated with one of more computational operations . . ." *See* '433 patent at claim 2. Claim 3 and claim 5 depend from claim 1, and further limit the control systems' determination of a performance strategy. *See, e.g.*, '433 patent at claim 3, 5.

117) The Court finds as a matter of fact that Storms' Email does meet claim 2 of the '433 patent because Plaintiffs have established by clear and convincing evidence that Storms did conceive of a system that monitored the price of power from the power grid and a plurality of parameters associated with one or more computational operations. Both Storms' Diagram and the second category of Storms' Source Code corroborate that Storms conceived of the BearBox

System as monitoring both the price of power and other various parameters associated with one or more computational operations. *See* FF at ¶¶ 45-47, 79; TX-171 at 2; *see also* Tr. 349:17-354:19. The Court also finds as a matter of fact that Storms communicated the concept of claim 2 of the '433 patent to Defendants on May 9, 2019, when Storms emailed Storms' Data File and Storms' Diagram to McNamara. *See* FF at ¶¶ 73-74. However, the Court also finds as a matter of fact that Storms did not communicate the concept of claim 2 of the '433 patent to Defendants prior to Defendants' independent conception. By at least January 2018, Lancium's system was monitoring conditions, including economic conditions, to control its computing systems on a granular level—as disclosed in the '632 Application. *See* FF at ¶¶ 54-56. And, by no later than October 2018, Lancium's system at its Thomas Road R&D Facility was monitoring conditions including power price, Bitcoin price, network and global hashrate, LMP, ERCOT parameters, and weather conditions to determine a performance strategy based on the profitability of mining Bitcoin. *See* FF at ¶¶ 57-58.

118) Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms communicated the subject matter of claim 2 of the '433 patent prior to Defendants' independent conception. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms' Email significantly contributed to claim 2 of the '433 patent because Defendants had independently conceived of the subject matter more than one year before receiving Storms' Email. *See* FF at ¶¶ 54-56.

119) The Court finds as a matter of fact that Storms' Email does not meet claim 3 of the '433 patent because the Court has already found as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms conceived of a system configured to receive

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power option data based, at least in part, on a power option agreement, which specifies a set of minimum power thresholds and associated time intervals, i.e., element [b2] of claim 1 of the '433 patent. *See* FF at ¶ 106.

120) The Court also finds as a matter of fact that Storms' Email does not meet claim 5 of the '433 patent for the same reasons the Court found as a matter of fact that Storms' Email does not meet element [b3] of claim 1 of the '433 patent. *See* FF at ¶ 109.

121) Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of the subject matter of claim 3 or claim 5 of the '433 patent. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claim 3 or claim 5 of the '433 patent.

b. Claim 4

122) The parties dispute whether Storms' Email corroborates that Storms conceived of and communicated the subject matter of dependent claim 4 of the '433 patent to Defendants prior to Defendants' independent conception. D.I. 256 at 12-13; D.I. 258 at 13-14; *see also* D.I. 257 at ¶ 39.

123) Claim 4 of the '433 patent depends from claim 1, and recites:

> 4. The system of claim 3, wherein the performance strategy further comprises:
>
> > an order for the set of computing systems to follow when performing the one or more computational operations, wherein the order is based on respective priorities associated with the one or more computational operations.

See '433 patent at claim 4.

124) Plaintiffs assert that Storms' Data File, Storms' Diagram, and the BearBox Spec Sheet corroborate that Storms conceived of a system that "monitored and used this particular data in the manner recited in the claims." D.I. 257 at ¶ 39. Specifically, Plaintiffs' expert, Dr. McClellan, testified that Storms' Diagram and the BearBox Spec Sheet corroborate that the BearBox System "could individually instruct and remotely control PDU[s]," and "could individually instruct miners to turn on or off based on prioritization received from or imputed from Bitcoin mining – Bitcoin network data, power market data, and so on." Tr. 349:17-354:19. Dr. McClellan also testified that "[o]rdering of operations is a well known and conventional feature in computer operations," but that Storms' Data File also corroborates conception of this claim. Tr. 351:22-352:22.

125) The Court finds as a matter of fact that Storms' Email does not meet dependent claim 4 of the '433 patent for three reasons. First, the Court has already found as a matter of fact that, while both Storms' Spec Sheet and Storms' Diagram describe the BearBox System as capable of custom remote control over the PDUs, Plaintiffs did not otherwise proffer evidence establishing that the BearBox System could individually control the system of 272 miners. TX-171. The Court also found Baer's testimony that Storms' Source Code "only ever instructs . . . all the relays of the PDUs to turn on or off" to be more credible than Dr. McClellan's testimony. Tr. 643:16-645:9; *see* FF at ¶ 113. Second, the Court finds Cline's testimony that Lancium was considering "configurable algorithms" to permit its software to prioritize computing workloads by no later than April 11, 2018, credible. Tr. 452:10-453:13; *see also* TX-199; TX-200 at 00016282. Third, by at least January 11, 2019, Defendants had conceived of a system that performed computational operations based on respective priorities—as disclosed in the '532 Application. *See* TX-165 at ¶ 53; *see* FF at ¶ 59. Thus, even if Storms' Email did meet dependent claim 4 of the '433 patent, the

Court finds as a matter of fact that Defendants' independent conception of claim 4 of the '433 patent precedes Storms' Email.

126) Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of the subject matter of claim 4 of the '433 patent. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claim 4 of the '433 patent.

c. Claims 6-8, 13-14, and 19

127) The parties dispute whether Storms' Email corroborates that Storms conceived of and communicated the subject matter of dependent claims 6-8, 13-14, and 19 of the '433 patent to Defendants prior to Defendants' independent conception. D.I. 256 at 13 (citing D.I. 257 at ¶ 40); D.I. 258 at 14.

128) Claims 6-8 depend from claim 1, and recite additional limitations related to power option data, minimum power thresholds, and power consumption targets, such that the system determines and implements a revised performance strategy. *See* '433 patent at claim 6, 7, 8. Claim 13 depends from claim 1, and recites that the second time interval associated with a minimum power threshold is subsequent to the first time interval associated with a minimum power threshold. *Id.* at claim 13. Claim 14 depends from claim 1, and adds that the performance strategy comprises a first power consumption target equal to or greater than the first minimum power threshold, and a second power consumption target equal to or greater than the second minimum power threshold. *Id.* at claim 14. Claim 19 depends from claim 17, and recites additional limitations related to power option data, minimum power thresholds, and reduced power

consumption targets, so that the system determines and implements a modified performance strategy. *Id.* at claim 19.

129) Plaintiffs rely on the same evidence offered to establish that Storms conceived of the subject matter of claim 1 of the '433 patent—including Storms' Data File, the BearBox Spec Sheet, Storms' Diagram, and Storms' Source Code—to support its contention that Storms conceived of a "system [that] used monitored conditions and power option data over multiple, consecutive intervals in the manner recited in the claims." D.I. 256 at 13; *see also* D.I. 257 at ¶ 40 (citing Tr. 354:20-359:15; TX-24; TX-157; TX-46).

130) The Court finds as a matter of fact that Storms' Email does not meet the elements of dependent claims 6-8, 13-14, and 19 of the '433 patent. The Court has already found as a matter of fact that Plaintiffs did not establish by clear and convincing evidence that Storms communicated preamble [a] of claims 1, 17, and 20 or elements [b] and [b1] of claim 1 of the '433 patent prior to Defendants' independent conception. *See* FF at ¶¶ 95, 98. The Court has also found as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms conceived of elements [b2], [b3], or [b4] of claim 1 of the '433 patent. *See* FF at ¶¶ 106, 110, 114. Based on these findings, and because Plaintiffs rely on identical evidence proffered in support of conception of the elements of claim 1 of the '433 patent, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of the subject matter of claims 6-8, 13-14, and 19 of the '433 patent. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claims 6-8, 13-14, and 19 of the '433 patent.

d. Claims 9-12 and 18

131) The parties dispute whether Storms' Email corroborates that Storms conceived of and communicated the subject matter of dependent claims 9-12 and 18 of the '433 patent to Defendants prior to Defendants' independent conception. D.I. 256 at 13-14 (citing D.I. 257 at ¶ 41); D.I. 258 at 14.

132) Claims 9-12 depend from claim 1, while claim 18 depends from claim 17. *See* '433 patent at claim 9, 10, 11, 12, 18. Claim 9 recites that "the control system is a remote master control system positioned remotely from the set of computing systems." *Id.* at claim 9. Claim 10 recites that "the control system is a mobile computing device," *id.* at claim 10, while claim 11 adds that "the control system is configured to receive the power option data while monitoring the set of conditions." *Id.* at claim 11. Claim 12 recites that the control system is configured to request and receive power option data from a qualified scheduling entity ("QSE"). *Id.* at claim 12. Claim 18 adds that the performance strategy further comprises instructions so that the computing systems can operate at an increased frequency based on a combination of power option data and information about the set of computing systems. *Id.* at claim 18.

133) Plaintiffs assert that claims 9-12 and 18 add "conventional features well-known in the art, each of which was incorporated into Storms' [BearBox System] and communicated to Lancium" through Storms' Email. D.I. 256 at 13; *see also* D.I. 257 at ¶ 41. For example, Plaintiffs contend that Storms conceived of the subject matter of claim 9 of the '433 patent because Storms' Diagram and the BearBox Spec Sheet corroborate that the BearBox System could remotely control PDUs. *Id.*; Tr. 359:20-362:7. Similarly, Plaintiffs assert that the BearBox Spec Sheet demonstrates that the BearBox System ran on a mobile computing device, i.e., Storms' laptop, Tr. 362:8-23, which meets claim 10 of the '433 patent. D.I. 257 at ¶ 41. Claim 11 is purportedly met

because the BearBox Spec Sheet and Storms' Data File show that the BearBox System was retrieving conditions associated with the power markets and Bitcoin in 5-minute intervals. Tr. 362:24-365:5. Finally, Plaintiffs contend that the subject matter of claim 12 of the '433 patent was a "functionality that existed in ERCOT for 20 years." D.I. 257 at ¶ 41 (citing Tr. 365:6-18; Tr. 193:18-197:7).

134) The Court finds as a matter of fact that Storms' Email does meet claim 9 of the '433 patent because Plaintiffs have established by clear and convincing evidence that Storms did conceive of a system that could remotely control PDUs. Both Storms' Diagram and the BearBox Spec Sheet corroborate that Storms conceived of the BearBox System as being capable of remotely controlling the system's PDUs. Tr. 359:20-362:7; *see* TX-171 at 1-2. The Court also finds as a matter of fact that Storms communicated the concept of claim 9 of the '433 patent to Defendants on May 9, 2019, when Storms emailed Storms' Diagram and the BearBox Spec Sheet to McNamara. *See* FF at ¶¶ 73-74. However, the Court also finds as a matter of fact that Storms did not communicate the concept of claim 9 of the '433 patent to Defendants prior to Defendants' independent conception. By at least October 2018, Lancium's control system operated remotely from its flexible datacenters. Tr. 463:24-464:13; TX-176 at 00014629; *see also* FF at ¶¶ 57-58.

135) Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms communicated the subject matter of claim 9 of the '433 patent prior to Defendants' independent conception. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms' Email significantly contributed to claim 9 of the '433 patent because Defendants had independently conceived of, and reduced to practice, the subject matter prior to receiving Storms' Email. *See* FF at ¶¶ 57-58.

136) The Court finds as a matter of fact that Storms' Email does meet claim 10 of the '433 patent because Plaintiffs have established by clear and convincing evidence that Storms did conceive of a control system that is a mobile computing device. Both Storms' Diagram and the BearBox Spec Sheet corroborate that Storms conceived of the BearBox System as operating via a mobile computing device, such as Storms' laptop. Tr. 362:8-23; *see* TX-171 at 1-2. The Court also finds as a matter of fact that Storms communicated the concept of claim 10 of the '433 patent to Defendants on May 9, 2019, when Storms emailed Storms' Diagram and the BearBox Spec Sheet to McNamara. *See* FF at ¶¶ 73-74. However, the Court also finds as a matter of fact that Storms did not communicate the concept of claim 10 of the '433 patent to Defendants prior to Defendants' independent conception. By at least January 2018, Lancium conceived of its control system operating via a mobile computing device. *See* TX-163 at ¶¶ 29-30; TX-189 at 00015148-149); *see also* FF at ¶ 58.

137) Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms communicated the subject matter of claim 10 of the '433 patent prior to Defendants' independent conception. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms' Email significantly contributed to claim 10 of the '433 patent because Defendants had independently conceived of the subject matter prior to receiving Storms' Email. *See* FF at ¶ 58.

138) The Court finds as a matter of fact that Storms' Email does not meet dependent claim 11 of the '433 patent. The Court has already found as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms conceived of element [b2] of claim 1 of the '433 patent. *See* FF at ¶ 106. Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of the subject matter

of claim 11 of the '433 patent. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claim 11 of the '433 patent.

139) The Court finds as a matter of fact that Storms' Email does not meet dependent claim 12 of the '433 patent for three reasons. First, there is no dispute that Storms' Email, including Storms' Diagram and Storms' Data File, never refers to a QSE. TX-171; TX-175; Tr. 365:13-18. Second, there is no dispute that requesting and receiving power option data from a QSE was well-known and conventional within ERCOT for nearly two decades. *See, e.g.*, Tr. 365:6-18; Tr. 193:18-197:7. Third, Baer credibly testified that Storms' Source Code does not "provide a request to a qualified scheduling entity (QSE)," or receive power option data in response to such a request. Tr. 665:12-666:18. In fact, Storms' Source Code does not receive power option data because the "kW_load" value is hard-coded, meaning the only way to modify that value is to physically change the code. *See* Tr. 665:12-666:9; *see also* FF at ¶ 49. Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of, or communicated, the subject matter of claim 12 of the '433 patent. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claim 12 of the '433 patent.

140) The Court finds as a matter of fact that Storms' Email does not meet dependent claim 18 of the '433 patent. Plaintiffs assert that Storms' Diagram corroborates that the BearBox System used "the cgminer software . . . [to] provide[] the ability to increase the frequency at which the miner's operate." D.I. 256 at 14; *see* TX-171. However, neither party disputes that cgminer software is open-source software that has been publicly available since 2015. *See, e.g.*, Tr. 371:21-

372:15; Tr. 668:21-669:12. Moreover, Defendants contend, and Plaintiffs do not dispute, that the cgminer software was not written by Storms and that it is not an instruction used in Storms' Source Code. Tr. 669:9-670:12. That the cgminer software was not written by Storms, or even incorporated into Storms' Source Code, belies Storms' assertion that the BearBox System could increase the frequency at which the miners operate. Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of the subject matter of claim 18 of the '433 patent. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claim 18 of the '433 patent.

e. Claim 16

141) The parties dispute whether Storms' Email—specifically, Storms' Data File—corroborates that Storms conceived of and communicated the subject matter of dependent claim 16 of the '433 patent to Defendants prior to Defendants' independent conception. D.I. 256 at 14 (citing D.I. 257 at ¶ 42); D.I. 258 at 14-15.

142) Claim 16 depends from claim 1 and reads:

> 16. The system of claim 1, wherein the set of conditions monitored by the control system further comprise:
>
> a price of power from the power grid; and
>
> a global mining hash rate and a price for a cryptocurrency; and
>
> wherein the control system is configured to:
>
> determine the performance strategy for the set of computing systems based on a combination of at the portion of the power option data, the price of power from the power grid, the global mining hash rate and the price for the cryptocurrency,
>
> wherein the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the

> cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

See '433 patent at claim 16.

143) Plaintiffs assert that Storms' Data File corroborates Storms' conception of a system that "compared mining profitability and instructed miners to mine Bitcoin when mining revenue was greater than the price of power from the power grid as recited in claim 16." D.I. 256 at 14 (citing D.I. 257 at ¶ 42). Specifically, Storms' Data File purportedly corroborates that the BearBox System "compared the revenue obtained by performing mining operations for Bitcoin," i.e., column H of Storms' Data File, "and mined Bitcoin in circumstances in which the price of power from the grid," i.e., column J of Storms' Data File, "was equal or less than the revenue obtainable from mining Bitcoin." *Id.* (citing D.I. 257 at ¶ 43); *see also* Tr. 309:12-13; Tr. 311:17-21, 313:21-22; Tr. 316:10-15, 317:4-8; Tr. 323:10-324:24.

144) The Court finds as a matter of fact that Storms' Email, including Storms' Data File, does not meet dependent claim 16 of the '433 patent for four reasons. First, the Court has already found as a matter of fact that, while both Storms' Spec Sheet and Storms' Diagram describe the BearBox System as capable of custom remote control over the PDUs, Plaintiffs did not otherwise proffer evidence establishing that the BearBox System could individually control the system of 272 miners. TX-171. The Court also found Baer's testimony that Storms' Source Code "only ever instructs . . . all the relays of the PDUs to turn on or off" to be more credible than Dr. McClellan's testimony. Tr. 643:16-645:9; *see* FF at ¶ 113. Second, the Court finds Baer's testimony that Storms' Source Code does not instruct miners to turn on, i.e., mine, when the price of power is equal to the mining revenue to be credible. *See* FF at ¶ 47. Baer testified that Storms' Source Code compares the breakeven cost to the day-ahead and real-time energy prices, and then

(i) sends signals to turn off all miners connected to the BearBox System if either the energy price is greater than or equal to the breakeven cost, or (ii) sends signals to turn on all miners connected to the BearBox System if the energy price is less than the breakeven cost. Tr. 647:5-653:23, 658:23-659:3; TX-22; *see* FF at ¶ 47. Third, Storms admitted that he was not the first person to consider the energy cost to mine Bitcoin versus the revenue that could be earned mining Bitcoin, and based on that data, decide whether to mine or not based on profitability. *See* Tr. 144:11-16; Tr. 613:5-615:1. Storms' admission is corroborated by Plaintiffs' expert, McCamant, who testified that comparing the real-time energy market price to the day-ahead energy price to decide whether to sell power back was a well-known form of arbitrage before May 2019. Tr. 204:14-23. McCamant also agreed that curtailing consumption of energy when the price of power exceeds a certain threshold was well known before May 2019 and may even be the most common form of energy arbitrage. Tr. 204:24-205:12. Fourth, the Court has already found as a matter of fact that Defendants independently conceived of a system that monitored the price of power from the power grid, global mining hash rate, and the price of Bitcoin prior to receiving Storms' Email. *See* FF at ¶¶ 97-98.

145) Accordingly, the Court finds as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of, or communicated, the subject matter of claim 16 of the '433 patent. Based on this finding, the Court also finds as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claim 16 of the '433 patent.

II. PLAINTIFFS' SOLE INVENTORSHIP CLAIM

A. Legal Standard

"Patent issuance creates a presumption that the named inventors are the true and only inventors." *Caterpillar Inc. v. Sturman Industries, Inc.*, 387 F.3d 1358, 1377 (Fed. Cir. 2004) (citing *Hess v. Advanced Cardiovascular Sys., Inc.*, 106 F.3d 976, 980 (Fed. Cir. 1997)). However, a party may rebut this presumption by proving, through clear and convincing evidence, that he is entitled to be named as an inventor and, thus, should have been included on the patent. *See Eli Lilly & Co. v. Aradigm Corp.*, 376 F.3d 1352, 1358 (Fed. Cir. 2004); *Checkpoint Systems, Inc. v. All–Tag Sec. S.A.*, 412 F.3d 1331, 1338 (Fed. Cir. 2005). Although failure to include an actual inventor on a patent is ordinarily grounds for invalidating that patent, 35 U.S.C. § 256 explicitly permits a court to order the patent's correction. *See Checkpoint Sys., Inc.*, 412 F.3d at 1338 ("If a patentee can demonstrate that inventorship can be corrected as provided by [35 U.S.C. § 256], a district court must order correction of the patent, thus saving it from being rendered invalid." (quoting *Pannu v. Iolab Corp.*, 155 F.3d 1344, 1350 (Fed. Cir. 1998))).

A claim of sole inventorship is predicated on proving that the proposed inventor conceived of the total patented invention. *Ferring B.V. v. Allergan, Inc.*, 166 F. Supp. 3d 415, 424 (S.D.N.Y. 2016); *see also Univ. of Pittsburgh of Commonwealth Sys. of Higher Educ. v. Hedrick*, 2008 WL 8627085, at *7 (C.D. Cal. June 9, 2008) ("Plaintiffs must show that they conceived of every claim of the patent and that any contribution by [the named inventors] to the conception of each and every claim was insignificant."). "Conception is the touchstone of inventorship, the completion of the mental part of invention," and is generally understood to be "a definite and permanent idea of the complete and operative invention, as it is hereafter to be applied in practice." *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1227-28 (Fed. Cir. 1994) (internal quotations

omitted). A party may demonstrate conception "only when the idea is so clearly defined in the inventor's mind that only ordinary skill would be necessary to reduce the invention to practice, without extensive research or experimentation." *Id.* at 1228. Notably, "an inventor need not know that his invention will work for conception to be complete," but rather "need only show that he had the idea; the discovery that an invention works is part of its reduction to practice." *Id.* (citations omitted). Further, the proposed inventor "must also show that the person to be removed did not contribute to the invention of any of the allowed claims." *Beriont v. GTE Labs., Inc.*, 601 F. App'x 937, 940 (Fed. Cir. 2015) (quoting *Univ. of Pittsburgh of Commonwealth Sys. of Higher Educ. v. Hedrick*, 573 F.3d 1290, 1297 (Fed. Cir. 2009)) (internal quotations omitted).

As a claim of sole inventorship requires proof by clear and convincing evidence, the party seeking to be added as an inventor "must prove his conception by corroborating evidence, preferably by showing a contemporaneous disclosure." *Id.* at 1228. This is so because of "the temptation for even honest witnesses to reconstruct, in a manner favorable to their own position, what their state of mind may have been years earlier." *Hess*, 106 F.3d at 980 (internal quotations and citations omitted). Therefore, "[a]n alleged co-inventor's testimony, or the testimony of the inventor himself, standing alone, cannot provide clear and convincing evidence of conception." *Univ. of Pittsburg*, 2008 WL 8627085, at *9 (citing *Caterpillar Inc.*, 387 F.3d at 1377). Instead, the inventor must independently corroborate its alleged conception through "testimony of a witness . . . to the actual reduction to practice," or "evidence of surrounding facts and circumstances independent of information received from the inventor." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1171 (Fed. Cir. 2006). Documentary or physical evidence made contemporaneously with the inventive process generally provides the most reliable proof of corroboration. *See Sandt Tech., Ltd. v. Resco Metal & Plastics Corp.*, 264 F.3d 1344, 1350-51

(Fed. Cir. 2001). Ultimately, the Court evaluates the sufficiency of the corroborating evidence under a "rule of reason" analysis, which requires evaluating all pertinent evidence so that a sound determination of credibility of the alleged inventor's story may be reached. *Ethicon, Inc. v. U.S. Surgical Corp.*, 135 F.3d 1456, 1464 (Fed. Cir. 1998).

B. Discussion

Plaintiffs argue that, because Storms solely conceived of all the claimed subject matter of the '433 patent, the inventorship of the '433 patent should be corrected to reflect that Austin Storms is the sole inventor. D.I. 256 at 2; D.I. 260 at 9. The Court has already found as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms conceived of elements [b2], [b3], or [b4] of claim 1 of the '433 patent. *See* FF at ¶¶ 106, 110, 114. Moreover, the Court has also found as a matter of fact that Plaintiffs did not establish by clear and convincing evidence that Storms communicated preamble [a] of claims 1, 17, and 20 or elements [b] and [b1] of claim 1 of the '433 patent prior to Defendants' independent conception. *See* FF at ¶¶ 95, 98. Accordingly, as a matter of law, Plaintiffs have not established that Storms is the sole inventor of the claimed inventions of the '433 patent.[5]

[5] Throughout its post-trial briefing, Plaintiffs continually criticize Defendants for not presenting testimonial evidence regarding McNamara and Cline's independent conception of the claimed inventions of the '433 patent. *See, e.g.*, D.I. 256 at 18-20; D.I. 260 at 5-6. This, however, is a red herring. "Patent issuance creates a presumption that the named inventors are the true and only inventors." *Caterpillar Inc.*, 387 F.3d at 1377 (citing *Hess*, 106 F.3d at 980). It is Plaintiffs' burden to prove, by clear and convincing evidence, that Storms conceived of the claimed inventions of the '433 patent. *Burroughs Wellcome*, 40 F.3d at 1227-28. While McNamara and Cline's actions inform the Court's analysis under the "rule of reason," *see Ethicon, Inc.*, 135 F.3d at 1464-65, the burden to establish, through corroborating evidence, that Storms conceived of each claim of the '433 patent remains with Plaintiffs.

III. PLAINTIFFS' JOINT INVENTORSHIP CLAIM

A. Legal Standard

A purported joint inventor who was erroneously omitted from a patent may seek the correction of the patent in federal court. *See* 35 U.S.C. § 256. However, the purported joint inventor must overcome the presumption that the named inventors of a patent are correct by meeting the heavy burden of proving his case by clear and convincing evidence. *Hess*, 106 F.3d at 980. To satisfy this standard, the claimed joint inventor must provide evidence corroborating his testimony concerning conception of the invention, including contemporaneous documentary or physical evidence, oral testimony of others, and circumstantial evidence. *See Ethicon, Inc.*, 135 F.3d at 1461; *Trovan, Ltd.*, 299 F.3d at 1303. The Court evaluates the sufficiency of the claimed joint inventor's corroborating evidence under a "rule of reason" analysis, whereby the Court views all evidence before making a sound determination as to the credibility of the claimed inventor's story. *See Trovan, Ltd.*, 299 F.3d at 1295.

Joint inventorship differs from sole inventorship in that "[a] joint invention is the product of a collaboration between two or more persons working together to solve the problem addressed." *Burroughs Wellcome*, 40 F.3d at 1227 (citing 35 U.S.C. § 116; *Kimberly-Clark Corp. v. Procter & Gamble Distrib. Co.*, 973 F.2d 911, 917 (Fed. Cir. 1992)). People may be joint inventors "even though they do not physically work on the invention together or at the same time, and even though each does not make the same type or amount of contribution." *Id.* However, the "individual must make a contribution to the conception of the claimed invention that is not insignificant in quality, when that contribution is measured against the dimension of the full invention." *Fina Oil & Chem. Co. v. Ewen*, 123 F.3d 1466, 1473 (Fed. Cir. 1997); *see also Eli Lilly & Co.*, 376 F.3d at 1358; *Ethicon Inc.*, 135 F.3d at 1460. There is no "lower limit on the quantum or quality of the inventive

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contribution required for a person to qualify as a joint inventor," and a meaningful contribution to the conception of even one claim in a patent can suffice to establish inventorship. *Id.* (citation and quotation marks omitted); *Cook Biotech Inc. v. Acell, Inc.*, 460 F.3d 1365, 1373 (Fed. Cir. 2006); *Eli Lilly & Co.*, 376 F.3d at 1358-59 (referring to the inventors having "some open line of communication during or in temporal proximity to their inventive efforts."). That is to say that joint inventors need not (1) "physically work together or at the same time," (2) "make the same type or amount of contribution," or (3) "make a contribution to the subject matter of every claim of the patent." *Vanderbilt Univ. v. ICOS Corp.*, 601 F.3d 1297, 1302 (Fed. Cir. 2010) (citation omitted); *Kimberly-Clark*, 973 F.2d at 917 (joint behavior may include "collaboration or working under common direction, one inventor seeing a relevant report and building upon it or hearing another's suggestion at a meeting."). However, a joint inventor must "do more than merely explain to the real inventors well-known concepts and/or the current state of the art," *Magnetar Techs. Corp. v. Six Flags Theme Parks, Inc.*, No. 07-127-LPS-MPT, 2017 WL 962760, at *7 (D. Del. Mar. 13, 2017) (quoting *Pannu*, 155 F.3d at 1351), and cannot "merely suggest[] an idea of a result to be accomplished, rather than means of accomplishing it . . ." *Nartron Corp. v. Schukra U.S.A., Inc.*, 558 F.3d 1352, 1359 (Fed. Cir. 2009) (quoting *Garrett Corp. v. United States*, 422 F.2d 874, 881 (Ct. Cl. 1970)).

Ultimately, "[t]he determination of whether a person is a joint inventor is fact specific, and no bright-line standard will suffice in every case." *Fina Oil & Chem.*, 123 F.3d at 1473.

B. Discussion

Plaintiffs argue that, at a minimum, Storms conceived of some of the claimed subject matter of the '433 patent and, thus the inventorship of the '433 patent should be corrected to reflect that Storms is a joint inventor. D.I. 256 at 15; D.I. 260 at 8-9. Specifically, Plaintiffs assert that

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Storms' Email satisfies the collaboration requirement for joint inventorship, *see* D.I. 256 at 16-17, while Storms' contribution to the conception of some of the claims of the '433 patent—specifically, the "monitored conditions" limitation recited in each claim, and claim 16—was significant in both quantity and quality. *Id.* at 17-18.

Plaintiffs assert that "Storms' contribution of monitored conditions, as recited in all 20 claims, was a significant contribution that forms a basis upon which the other aspects of the claim are built," which, together with communicating this concept to Defendants through Storms' Email, entitles Storms to be named a joint inventor of the '433 patent. *Id.* at 17-18. The Court has already found as a factual matter that Plaintiffs have failed to prove by clear and convincing evidence that Storms communicated the "monitored conditions" limitation, i.e., element [b1],. of claims 1, 17, and 20 of the '433 patent prior to Defendants' independent conception. *See* FF at ¶ 98. Accordingly, as a matter of law, Plaintiffs have not established that Storms is a joint inventor with respect to the "monitored conditions" limitations recited in each claim of the '433 patent.

Additionally, Plaintiffs assert that "Storms [] made a significant contribution in the form of his profitability analysis embodied in claim 16," because, as shown in Storms' Data File, the BearBox System "compared the revenue obtained by performing mining operations for Bitcoin (mining_rev, column H), and mined Bitcoin in circumstances in which the price of power from the grid (real_time_LMP, column J) was equal or less than the revenue obtainable from mining Bitcoin." D.I. 256 at 18. The Court has already found as a matter of fact that Plaintiffs have failed to prove by clear and convincing evidence that Storms conceived of, or communicated, the subject matter of claim 16 of the '433 patent. *See* FF at ¶ 145. Further, the Court also found as a factual matter that Plaintiffs failed to establish by clear and convincing evidence that Storms' Email significantly contributed to the subject matter of claim 16 of the '433 patent. *See* FF at ¶ 145.

Accordingly, as a matter of law, Plaintiffs have not established that Storms is a joint inventor with respect to claim 16 of the '433 patent.

Storms' purported contribution to the other claims of the '433 patent fare no better. The Court has already found as a matter of fact that Plaintiffs have failed to establish by clear and convincing evidence that Storms conceived of elements [b2], [b3], or [b4] of claim 1 of the '433 patent. *See* FF at ¶¶ 106, 110, 114. Moreover, the Court has also found as a matter of fact that Plaintiffs did not establish by clear and convincing evidence that Storms communicated preamble [a] of claims 1, 17, and 20 or elements [b] and [b1] of claim 1 of the '433 patent prior to Defendants' independent conception. *See* FF at ¶¶ 95, 98. Accordingly, as a matter of law, Plaintiffs have not established that Storms is a joint inventor of claim 1 of the '433 patent.

As to dependent claims 3-8, 11-14, 18, and 19 of the '433 patent, the Court has already found as a matter of fact that Plaintiffs failed to establish by clear and convincing evidence that Storms conceived of the subject matter of dependent claims 3-8, 11-14, 18, and 19. *See* FF at ¶¶ 121, 126, 130, 138-140. Based on these findings, the Court also found as a matter of fact that Plaintiffs failed to establish by clear and convincing evidence that Storms significantly contributed to the conception of dependent claims 3-8, 11-14, 18, and 19. *See* FF at ¶¶ 121, 126, 130, 138-140. Accordingly, as a matter of law, Plaintiffs have not established that Storms is a joint inventor of claims 3-8, 11-14, 18, and 19 of the '433 patent. Finally, as to dependent claims 2, 9, 10, and 12 of the '433 patent, the Court has already found as a matter of fact that Plaintiffs failed to establish by clear and convincing evidence that Storms communicated of the subject matter of dependent claims 2, 9, 10, and 12 prior to Defendants' independent conception. *See* FF at ¶¶ 118, 135, 137, 139. Given these findings, the Court also found as a matter of fact that Plaintiffs failed to prove by clear and convincing evidence that Storms' Email significantly contributed to

dependent claims 2, 9, 10, and 12 of the '433 patent because Defendants had independently conceived of the subject matter prior to receiving Storms' Email. *See* FF at ¶¶ 118, 135, 137, 139. Accordingly, as a matter of law, Plaintiffs have not established that Storms is a joint inventor of claims 2, 9, 10, and 12 of the '433 patent.

IV. CONCLUSION

For the reasons discussed above, the Court finds that Plaintiffs have not met their burdens to establish their sole and/or joint inventorship claims. Accordingly, the Court will enter judgment in favor of Defendants.

The Court will issue an Order directing the parties to submit a proposed order by which the Court may enter final judgment consistent with this Opinion.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR., Defendants.	C.A. No. 21-534-GBW-CJB

FINAL JUDGMENT

This action, having come before the Court for a bench trial from December 6 through December 8, 2022, the Honorable Gregory B. Williams, United States District Judge, presiding, and the Court having heard the evidence and testimony of witnesses of Plaintiffs BearBox LLC and Austin Storms (collectively, "Plaintiffs") and Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline, Jr. (collectively, "Defendants");

AND WHEREAS the Court issued a post-trial Opinion (D.I. 262) and Order (D.I. 263) on March 6, 2023, finding in favor of Defendants and against Plaintiffs on Count I and Count II of Plaintiffs' Second Amended Complaint (D.I. 103) (the "SAC"), which alleged claims seeking to correct inventorship for U.S. Patent No. 10,608,433 (the "'433 Patent") to name Austin Storms as the sole or a joint inventor of the '433 Patent;

AND WHEREAS the Court issued a Minute Entry on April 25, 2022 striking Count III and Count IV of the SAC, which alleged claims of trade secret misappropriation against Defendants;

AND WHEREAS the Court issued a Memorandum Opinion (D.I. 212) and Order (D.I. 213) on October 7, 2022, adopting a Report and Recommendation issued on May 26, 2022

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(D.I. 143), dismissing with prejudice Count VI of the SAC alleging unjust enrichment against Defendants;

AND WHEREAS the Court issued a Memorandum Opinion (D.I. 230) and Order (D.I. 231) on November 14, 2022 granting summary judgment in favor of Defendants and against Plaintiffs on Count V of the SAC alleging conversion against Defendants;

AND WHEREAS the Court issued an Order (D.I. 97) on February 2, 2022, adopting a Report and Recommendation issued on January 18, 2022 (D.I. 92), dismissing with prejudice Count V (negligent misrepresentation) of Plaintiffs' Amended Complaint (D.I. 19);

IT IS HEREBY ORDERED AND ADJUDGED, as of the date written below, that **Final Judgment is entered as follows**:

1. Final Judgment is entered in favor of Defendants and against Plaintiffs on Count I of the SAC seeking to correct inventorship of the '433 Patent under 35 U.S.C. § 256 to name Austin Storms the sole inventor of the '433 Patent;

2. Final Judgment is entered in favor of Defendants and against Plaintiffs on Count II of the SAC seeking to correct inventorship of the '433 Patent under 35 U.S.C. § 256 to name Austin Storms a joint inventor of the '433 Patent;

3. Final Judgment is entered in favor of Defendants and against Plaintiffs on Counts III-VI of the SAC alleging trade secret misappropriation, conversion, and unjust enrichment, respectively;

4. Final Judgment is entered in favor of Defendants and against Plaintiffs on Count V of the Amended Complaint alleging negligent misrepresentation;

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5. Final Judgment is entered in favor of Defendants and against Plaintiffs on Count I of Defendants' Second Amended Counterclaims (D.I. 145) (the "Counterclaims") seeking declaratory judgment that Austin Storms is not an inventor of the '433 Patent;

6. Final Judgment is entered in favor of Defendants and against Plaintiffs on Count II of the Counterclaims seeking declaratory judgment that Austin Storms has no ownership rights in the '433 Patent;

7. Final Judgment is entered in favor of Defendants and against Plaintiffs on Count III of the Counterclaims seeking declaratory judgment that Defendants did not steal or otherwise improperly obtain or use any information from Plaintiffs.

IT IS FURTHER ORDERED that the deadline for any party to move for costs and/or attorney's fees (including, but not limited to, under 35 U.S.C. § 285) is fourteen (14) days after the entry of this Final Judgment.

SO ORDERED AND FINAL JUDGMENT IS HEREBY ENTERED

this 5th day of April, 2023.

GBWms.

THE HONORABLE GREGORY B. WILLIAMS
UNITED STATES DISTRICT JUDGE

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR., Defendants.	C.A. No. 21-534-GBW

Andrew C. Mayo, ASHBY & GEDDES, Wilmington, Delaware; Benjamin T. Horton, John R. Labbe, Raymond R. Ricordati III, Chelsea M. Murray, MARSHALL, GERSTEIN & BORUN LLP, Chicago, Illinois

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Counsel for Defendants

MEMORANDUM OPINION

FILED UNDER SEAL
November 14, 2022
Wilmington, Delaware

GREGORY B. WILLIAMS
UNITED STATES DISTRICT JUDGE

Plaintiffs BearBox LLC and Austin Storms (collectively, "BearBox") filed this action against Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline, Jr. (collectively, "Lancium"), seeking to correct the inventorship of United States Patent No. 10,608,433 ("the '433 patent"), which is assigned to Lancium and lists Michael T. McNamara ("McNamara") and Raymond E. Cline, Jr. ("Cline") as inventors. Additionally, BearBox seeks to recover for Lancium's conversion of BearBox's technology, which is alleged to have been implemented into Lancium's Smart Response™ software. Pending before the Court is Lancium's First Motion for Summary Judgment as to all of BearBox's claims. D.I. 148. The Court has reviewed the parties' respective briefing, statement of facts, and responses thereto. *See, e.g.*, D.I. 148; D.I. 149; D.I. 150; D.I. 151; D.I. 176; D.I. 177; D.I. 178; D.I. 179; D.I. 195; D.I. 196. For the reasons explained below, Lancium's First Motion for Summary Judgment is granted-in-part and denied-in-part.

I. BACKGROUND

BearBox and Lancium are technology companies at the crossroads of the cryptocurrency and renewable energy industries. Their dispute centers around a meeting and subsequent communications between BearBox's founder, Austin Storms, and Lancium's CEO, Michael T. McNamara, beginning at the Fidelity FCAT Mining Summit in Boston, Massachusetts on May 3, 2019. Based on this string of communications from May 3 to May 9, 2019, BearBox filed this suit against Lancium, asserting claims of sole inventorship, or alternatively, joint inventorship, of the '433 patent, theft of trade secrets, conversion, and unjust enrichment. D.I. 1; D.I. 103.

The Court struck BearBox's trade secret claims on April 22, 2022. D.I. 111. Shortly thereafter, Lancium filed a Motion to Dismiss BearBox's conversion and unjust enrichment claims

(D.I. 120), which the Court granted-in-part and dismissed the unjust enrichment claim. D.I. 212; D.I. 213. Lancium then filed its First Motion for Summary Judgment related to all remaining claims (D.I. 148), and later filed its Second Motion for Summary Judgment Regarding Damages and its Motion to Exclude Opinions of BearBox's Expert David Duski (D.I. 167). On October 31, 2022, Lancium filed its Motion to Bifurcate BearBox's Patent Inventorship Claims from BearBox's Conversion Claims, and requested expedited consideration. D.I. 222.

Lancium's First Motion for Summary Judgment ("Lancium's Motion") asserts that BearBox's inventorship claims fail as a matter of law because there is no evidence that Austin Storms conceived of, communicated, or collaborated on the inventions of the '433 patent. D.I. 149 at 1-2. Additionally, Lancium's Motion argues that BearBox's conversion claim fails as a matter of law because it is barred by Louisiana's one-year statute of limitations and, alternatively, is preempted by federal patent law. D.I. 149 at 30-36. BearBox disputes Lancium's Motion. D.I. 176; D.I. 177; D.I. 178; D.I. 179. To aid in the resolution of Lancium's Motion, the Court held a *Markman* hearing on October 20, 2022, and later issued a Markman opinion construing two disputed terms of the '433 patent: "power option agreement" and "minimum power threshold." D.I. 218; D.I. 219. Lancium's Motion is now ripe for resolution.

II. LEGAL STANDARD

"The court shall grant summary judgment if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a). Material facts are those "that could affect the outcome" of the proceeding. *Lamont v. New Jersey*, 637 F.3d 177, 181 (3d Cir. 2011) (quoting *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248 (1986)). "[A] dispute about a material fact is 'genuine' if the evidence is sufficient to permit a reasonable jury to return a verdict for the nonmoving party." *Id.* "The burden on the moving party may be discharged by pointing out to the district court that there is an absence of

evidence supporting the non-moving party's case." *Peloton Interactive, Inc. v. iFIT Inc.*, C.A. No. 20-1535-RGA, 2022 WL 1523112, at *1 (D. Del. May 13, 2022) (citing *Celotex Corp. v. Catrett*, 477 U.S. 317, 323 (1986)).

The burden then shifts to the non-movant to demonstrate the existence of a genuine issue for trial. *Matsushita Elec. Indus. Co. v. Zenith Radio Corp.*, 475 U.S. 574, 586-87 (1986); *Williams v. Borough of West Chester*, 891 F.2d 458, 460-61 (3d Cir. 1989). A non-moving party asserting that a fact is genuinely disputed must support such an assertion by: "(A) citing to particular parts of materials in the record, including depositions, documents, electronically stored information, affidavits or declarations, stipulations . . . , admissions, interrogatory answers, or other materials; or (B) showing that the materials cited [by the opposing party] do not establish the absence . . . of a genuine dispute . . . ." Fed. R. Civ. P. 56(c)(1).

When determining whether a genuine issue of material fact exists, the court must view the evidence in the light most favorable to the non-moving party and draw all reasonable inferences in that party's favor. *Wishkin v. Potter*, 476 F.3d 180, 184 (3d Cir. 2007). If the non-moving party fails to make a sufficient showing on an essential element of its case with respect to which it has the burden of proof, the moving party is entitled to judgment as a matter of law. *See Celotex Corp.*, 477 U.S. at 322.

III. DISCUSSION

Lancium argues that the Court must grant summary judgment as to BearBox's claims of sole and joint inventorship because BearBox has failed to produce any evidence that Austin Storms conceived of, or communicated to Lancium, the inventions claimed in the '433 patent. D.I. 149 at 9, 30. Separately, Lancium asserts that it is also entitled to summary judgment as to BearBox's joint inventorship claim because BearBox fails to proffer evidence that Austin Storms collaborated

with the named inventors of the '433 patent. Finally, Lancium argues that the Court must grant summary judgment as to BearBox's conversion claim because it is time-barred by Louisiana's one-year statute of limitations, or that BearBox's conversion claim is preempted by federal patent law. *Id.* at 30-36. BearBox disputes each of Lancium's arguments, asserting that the record is replete with genuine disputes of material fact that preclude summary judgment on all of BearBox's claims. *See* D.I. 176. The Court finds that there are genuine issues of material fact precluding summary judgment as to BearBox's sole and joint inventorship claim. However, the Court finds that Lancium is entitled to summary judgment as to BearBox's conversion claim.

A. Sole Inventorship

Lancium moves for summary judgment as to BearBox's sole inventorship claim, arguing that BearBox has failed to produce any evidence that Austin Storms conceived of, or communicated to Lancium, the inventions claimed in the '433 patent. D.I. 149 at 9. In response, BearBox asserts that there exists genuine issues of material fact regarding Storms' conception of the inventions claimed in the '433 patent that preclude summary judgment. D.I. 176 at 19. Further, BearBox avers that summary judgment must be denied because both testimony and documents produced as evidence corroborate BearBox's claim that Storms communicated the entirety of the inventions claimed in the '433 patent to Lancium. *Id.* at 25. Because the Court finds that the parties have genuine disputes of material fact as to what Austin Storms conceived of and what was communicated to Lancium, Lancium's Motion as to BearBox's sole inventorship claim is denied.

"Patent issuance creates a presumption that the named inventors are the true and only inventors." *Caterpillar Inc. v. Sturman Industries, Inc.*, 387 F.3d 1358, 1377 (Fed. Cir. 2004) (citing *Hess v. Advanced Cardiovascular Sys., Inc.*, 106 F.3d 976, 980 (Fed. Cir. 1997)). However, a party may rebut this presumption by proving, through clear and convincing evidence, that he is entitled to be named as an inventor and, thus, should have been included on the patent. *See Eli*

Lilly & Co. v. Aradigm Corp., 376 F.3d 1352, 1358 (Fed. Cir. 2004); *Checkpoint Systems, Inc. v. All–Tag Sec. S.A.*, 412 F.3d 1331, 1338 (Fed. Cir. 2005). Although failure to include an actual inventor on a patent is ordinarily grounds for invalidating that patent, 35 U.S.C. § 256 explicitly permits a court to order the patent's correction. *See Checkpoint Sys., Inc.*, 412 F.3d at 1338 ("If a patentee can demonstrate that inventorship can be corrected as provided by [35 U.S.C. § 256], a district court must order correction of the patent, thus saving it from being rendered invalid." (quoting *Pannu v. Iolab Corp.*, 155 F.3d 1344, 1350 (Fed. Cir. 1998))).

A claim of sole inventorship is predicated on proving that the proposed inventor conceived of the total patented invention. *Ferring B.V. v. Allergan, Inc.*, 166 F. Supp. 3d 415, 424 (S.D.N.Y. 2016); *see also Univ. of Pittsburgh of Commonwealth Sys. of Higher Educ. v. Hedrick*, 2008 WL 8627085, at *7 (C.D. Cal. June 9, 2008) ("Plaintiffs must show that they conceived of every claim of the patent and that any contribution by [the named inventors] to the conception of each and every claim was insignificant."). "Conception is the touchstone of inventorship, the completion of the mental part of invention," and is generally understood to be "a definite and permanent idea of the complete and operative invention, as it is hereafter to be applied in practice." *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1227-28 (Fed. Cir. 1994) (internal quotations omitted). A party may demonstrate conception "only when the idea is so clearly defined in the inventor's mind that only ordinary skill would be necessary to reduce the invention to practice, without extensive research or experimentation." *Id.* at 1228. Notably, "an inventor need not know that his invention will work for conception to be complete," but rather "need only show that he had the idea; the discovery that an invention works is part of its reduction to practice." *Id.* (citations omitted).

As a claim of sole inventorship requires proof by clear and convincing evidence, the party seeking to be added as an inventor "must prove his conception by corroborating evidence, preferably by showing a contemporaneous disclosure." *Id.* at 1228. This is so because of "the temptation for even honest witnesses to reconstruct, in a manner favorable to their own position, what their state of mind may have been years earlier." *Hess*, 106 F.3d at 980 (internal quotations and citations omitted). Therefore, "[a]n alleged co-inventor's testimony, or the testimony of the inventor himself, standing alone, cannot provide clear and convincing evidence of conception." *Univ. of Pittsburg*, 2008 WL 8627085, at *9 (citing *Caterpillar Inc.*, 387 F.3d at 1377). Instead, the inventor must independently corroborate its alleged conception through "testimony of a witness . . . to the actual reduction to practice," or "evidence of surrounding facts and circumstances independent of information received from the inventor." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1171 (Fed. Cir. 2006). Documentary or physical evidence made contemporaneously with the inventive process generally provides the most reliable proof of corroboration. *See Sandt Tech., Ltd. v. Resco Metal & Plastics Corp.*, 264 F.3d 1344, 1350-51 (Fed. Cir. 2001). Ultimately, the Court evaluates the sufficiency of the corroborating evidence under a "rule of reason" analysis, which requires evaluating all pertinent evidence so that a sound determination of credibility of the alleged inventor's story may be reached. *Ethicon, Inc. v. U.S. Surgical Corp.*, 135 F.3d 1456, 1464 (Fed. Cir. 1998).

The '433 patent comprises of twenty claims that generally relate to systems and methods for adjusting the amount of power available on the electrical grid based on interactions with the ancillary services markets. *See* '433 patent at Abstract. BearBox alleges that Austin Storms alone conceived of the subject matter in the '433 patent because Lancium merely commercialized Austin Storms' systems and methods—through Lancium's Smart Response™ software—after unlawfully

obtaining BearBox's proprietary technical documents during and after the Fidelity FCAT Mining Summit. D.I. 176 at 6-12. BearBox bases its sole inventorship claim on the following evidence: (1) a Product Details document emailed to Lancium which describes features related to a system operating at a maximum power load and having different power usage capabilities over specified periods of time, *see, e.g.*, D.I. 178 at ¶ 5; D.I. 179, Ex. E at 112:4-115:13 at 95:12; *id.* at Ex. B; (2) a diagram titled "BearBox Automatic Mining System Version 1.0," showing alternative periods of mining Bitcoin and curtailment based on external variables such as price of power, *see* D.I. 179, Ex. B; (3) an expert report detailing how BearBox's annotated diagram shows a system that "would operate with power generation assets and the software would continually determine whether it was more profitable to use the electricity from the generation assets to mine Bitcoin or to sell the electricity at the day-ahead or real-time LMP pricing," *see* D.I. 179, Ex. C at ¶ 64; *see also* D.I. 151, Ex. 3 at 53-80; (4) a proprietary .CSV file manipulating and modeling data to show mining or curtailment decisions being determined at regular time intervals, *see* D.I. 179, Ex. B; *see also* *id.*, Ex. H at 139-150; (5) and Storms' own detailed testimony related to his purported conception of the claimed invention and the events surrounding Storms and McNamara's communications, *see* D.I. 179, Ex. E at 86-113.

Viewing the evidence in the light most favorable to BearBox and drawing all reasonable inferences in its favor, *Wishkin*, 476 F.3d at 184, the Court finds that BearBox, at a minimum, has demonstrated the existence of genuine issues of material fact related to Austin Storms' conception of the subject matter of the '433 patent. At this stage, the present record is replete with testimony and documents that could support a factfinder's reasonable inference that Austin Storms conceived of the '433 patent's subject matter, as properly construed by this Court, prior to Lancium's purported conception. *See* D.I. 178 at ¶ 5; *see also* D.I. 179, Ex. A (undated images of BearBox's

hardware and software, and images of whiteboard drawings depicting BearBox's purported conception of the subject matter claimed in the '433 patent). Specifically, Storms testifies extensively to the details shared over dinner with McNamara, including a concept for software that provides fine grain control over mining machines and a system that could maximize profitability by calculating the most profitable times to mine for Bitcoin or curtail activities and sell power back to the grid. D.I. 179, Ex. E at 95:12-105:16. Acknowledging that an alleged inventor's own testimony is viewed with suspicion, *see Sandt Tech.*, 264 F.3d at 1350-51, BearBox corroborates the substance of Storms' communications through the Product Details document and the proprietary .CSV file, both of which were undisputedly emailed to Lancium following the dinner with McNamara. *See* D.I. 150 at ¶ 13; D.I. 177 at ¶ 13; D.I. 178 at ¶ 5. Using these documents, BearBox's expert, Dr. McClellan, maps each limitation claimed in the '433 patent to the systems and methods allegedly conceived by Storms.[1] *See* D.I. 151, Ex. 3 at 57-80.

Furthermore, Dr. McClellan identifies over forty functional source code files Storms disputedly created prior to his communications with McNamara, which BearBox alleges proves Storms' conception of all the claimed aspects of the '433 patent, including the retrieval of data from remote sources, profitability determinations, and controlling relays to power on miners. D.I. 176 at 26-27; *see also* D.I. 151, Ex. 3 at ¶¶ 54-169; D.I. 151 at Appendix A. BearBox asserts that, while Lancium never obtained these source code files, these files demonstrate a reduction to practice that is indicative of Storms' conception of the '433 patent's subject matter. D.I. 176 at 26-27; *see also Trovan, Ltd. V. Sokymat SA, Irori*, 299 F.3d 1292, 1309 (Fed. Cir. 2002)

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[1] To the extent Lancium argues that the corroborating documents BearBox cites do not use the terms, as properly construed, that are explicitly used in the '433 patent, it is understood that the original inventor need only demonstrate possession of the claimed subject matter—the inventor need not use a particular claim term. *Apotex Inc. v. Cephalon, Inc.*, 2011 WL 6090696, at *18 (E.D. Pa. Nov. 7, 2011), *aff'd*, 500 F. App'x 959 (Fed. Cir. 2013).

("[R]eduction to practice alone is evidence that [plaintiff] had a definite and permanent idea of the complete and operative invention."). In essence, BearBox's submissions with respect to the conception of the '433 patent's subject matter present ample analysis of, and support for, his claim of sole inventorship, as well as extensive analysis of both the scientific processes at issue and of the language in the patents themselves. Additionally, BearBox has demonstrated the potential for adequate corroboration, through both direct and circumstantial evidence, that Storms conceived of each limitation claimed in the '433 patent prior to Storms' communications with McNamara. *See, e.g.*, D.I. 151, Ex. 3 at 57-80; D.I. 151 at Appendix A; D.I. 150 ¶¶ 13, 17; D.I. 177 at ¶¶ 13,17. As such, BearBox has established the existence of genuine issues of material fact that preclude Lancium's Motion as to sole inventorship.

While Lancium contends that the present record is devoid of any evidence that supports BearBox's claim that Storms conceived of the entirety of the claimed subject matter of the '433 patent, Lancium's argument centers on disputes about the substance and weight of the testimony and corroborating documents that BearBox cites. D.I. 149 at 19-24; D.I. 195 at 11-15. Stated another way, Lancium disputes material facts that are essential to the resolution of who conceived of the subject matter of the '433 patent. At this stage, the Court is not equipped to weigh the volumes of evidence, especially in light of the fact that BearBox has established the existence of genuine issues of material fact. *See BASF Corp. v. SNF Holding Co.*, 955 F.3d 958, 963 (Fed. Cir. 2020) ("[A]t the summary judgment stage the judge's function is not himself to weigh the evidence . . . ." (internal quotation marks and citation omitted)). Additionally, Lancium conflates the required proof for corroboration. Lancium contends that the Federal Circuit in *Wagner v. Ashline*, 2021 WL 5353889 (Fed. Cir. Nov. 17, 2021) held that evidence corroborating only that the named inventor and alleged inventor met and discussed other topics is insufficient to meet the

corroboration standard. D.I. 149 at 23; D.I. 195 at 15. But, *Wagner* was not decided so narrowly. Rather, the Federal Circuit was concerned that the only probative evidence corroborating the alleged inventor's claim was from a non-party who testified that the meeting was focused on topics outside of the scope of the asserted patents. *Wagner*, 2021 WL 5353889, at *4-5. In fact, applying a "rule of reason" analysis, the Federal Circuit held that only testimony corroborating that the named inventor and alleged inventor met and discussed other topics, ***without additional documentary or testimonial evidence***, is by itself insufficient to meet the corroboration standard. *Id.* at *5 (emphasis added). Here, unlike *Wagner*, BearBox does not corroborate its inventorship claim solely through the testimony of Storms or a non-party; rather, BearBox offers testimonial evidence, expert reports, and contemporaneous technical documents to support its claim. *See, e.g.*, D.I. 151, Ex. 3 at 57-80; D.I. 151 at Appendix A; D.I. 178 at ¶¶ 4, 5.

Although BearBox's case for sole inventorship of the '433 patent may be less convincing with respect to some contributions or claims than it is for others, diving into the factual morass of analyzing each claim, a litany of technical documents, and source code files is not a task appropriate for the Court at the summary judgment stage. It is enough that the parties' respective submissions on this issue indicate the existence of disputed material facts that go directly to the heart of BearBox's claim of sole inventorship. Faced with all of the available documentary evidence, expert testimony, and disputed facts, the Court cannot say that no reasonable fact finder could find that there is clear and convincing evidence establishing Storms' right to be named as the sole inventor on the '433 patent. Summary judgment as to BearBox's sole inventorship claim is denied.

B. Joint Inventorship

Separately, Lancium argues that BearBox's joint inventorship claim fails as a matter of law because BearBox has failed to meet its burden of proving Storms collaborated on the inventions

claimed in the '433 patent. D.I. 149 at 24. As such, Lancium asserts that it is entitled to summary judgment on BearBox's joint inventorship claim. *Id.* at 24-30. BearBox disagrees, arguing that summary judgment is precluded because there exist multiple genuine issues of material fact related to Storms' contribution to the '433 patent's subject matter. D.I. 176 at 27. The Court agrees with BearBox that there are genuine issues of material fact that preclude summary judgment on BearBox's joint inventorship claim.

Like sole inventorship, a purported joint inventor who was erroneously omitted from a patent may seek the correction of the patent in federal court. *See* 35 U.S.C. § 256. However, the purported joint inventor must overcome the presumption that the named inventors of a patent are correct by meeting the heavy burden of proving his case by clear and convincing evidence. *Hess*, 106 F.3d at 980. To satisfy this standard, the claimed joint inventor must provide evidence corroborating his testimony concerning conception of the invention, including contemporaneous documentary or physical evidence, oral testimony of others, and circumstantial evidence. *See Ethicon, Inc.*, 135 F.3d at 1461; *Trovan, Ltd.*, 299 F.3d at 1303. The Court evaluates the sufficiency of the claimed joint inventor's corroborating evidence under a "rule of reason" analysis, whereby the Court views all evidence before making a sound determination as to the credibility of the claimed inventor's story. *See Trovan, Ltd.*, 299 F.3d at 1295.

Joint inventorship differs from sole inventorship in that "[a] joint invention is the product of a collaboration between two or more persons working together to solve the problem addressed." *Burroughs Wellcome*, 40 F.3d at 1227 (citing 35 U.S.C. § 116; *Kimberly-Clark Corp. v. Procter & Gamble Distrib. Co.*, 973 F.2d 911, 917 (Fed. Cir. 1992)). People may be joint inventors "even though they do not physically work on the invention together or at the same time, and even though each does not make the same type or amount of contribution." *Id.* However, the "individual must

make a contribution to the conception of the claimed invention that is not insignificant in quality, when that contribution is measured against the dimension of the full invention." *Fina Oil & Chem. Co. v. Ewen*, 123 F.3d 1466, 1473 (Fed. Cir. 1997); *see also Eli Lilly & Co.*, 376 F.3d at 1358; *Ethicon Inc.*, 135 F.3d at 1460. There is no "lower limit on the quantum or quality of the inventive contribution required for a person to qualify as a joint inventor," and a meaningful contribution to the conception of even one claim in a patent can suffice to establish inventorship. *Id.* (citation and quotation marks omitted); *Cook Biotech Inc. v. Acell, Inc.*, 460 F.3d 1365, 1373 (Fed. Cir. 2006); *Eli Lilly & Co.*, 376 F.3d at 1358-59 (referring to the inventors having "some open line of communication during or in temporal proximity to their inventive efforts."). That is to say that joint inventors need not (1) "physically work together or at the same time," (2) "make the same type or amount of contribution," or (3) "make a contribution to the subject matter of every claim of the patent." *Vanderbilt Univ. v. ICOS Corp.*, 601 F.3d 1297, 1302 (Fed. Cir. 2010) (citation omitted); *Kimberly-Clark*, 973 F.2d at 917 (joint behavior may include "collaboration or working under common direction, one inventor seeing a relevant report and building upon it or hearing another's suggestion at a meeting."). Ultimately, "[t]he determination of whether a person is a joint inventor is fact specific, and no bright-line standard will suffice in every case." *Fina Oil & Chem.*, 123 F.3d at 1473.

The crux of Lancium's argument is that the record is devoid of any evidence that there was "joint behavior" or "collaboration" between Storms and the named inventors, McNamara and Cline.[2] D.I. 149 at 25. In fact, Lancium asserts that the only communications between the

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[2] Lancium further argues that "Storms cannot be a joint inventor as a matter of law because . . . he did not contribute in any significant manner (or at all) to any claims of the '433 patent. Storms' 'system' was fundamentally different from the system claimed in the '433 patent." D.I. 195 at 16. However, the evidence offered to establish that Storms conceived of the entirety of the subject matter claimed in the '433 patent (i.e., to establish BearBox's sole inventorship claim) is identical

parties—a conversation at a group dinner following the Fidelity FCAT Mining Summit, a series of text messages between Storms and McNamara from May 3 to May 9, 2019, and an email Storms sent to McNamara with five attachments—fail, as a matter of law, to establish collaboration between the parties. *Id.* Notably, Lancium contends, and BearBox does not dispute, that four of the five attachments emailed to McNamara were publicly available, which Lancium asserts further weighs against a finding of collaboration. *See* D.I. 150 at ¶ 18; D.I. 177 at ¶ 18 (conceding that the attachments, except the .CSV file, are not confidential by themselves, but asserting that the entirety of the email, including all attachments, are confidential by virtue of the "Confidentiality Notice" at the bottom of that email).

Ultimately, rather than contest that there was no corroborating evidence supporting a finding of collaboration, Lancium's argument relates to the quantity and quality of the communications between the parties. In doing so, Lancium ignores the undisputed fact that McNamara communicated with Storms for the week following the Fidelity FCAT Mining Summit, including soliciting product details and supporting documents from Storms via text message. D.I. 150 at ¶ 12; D.I. 177 at ¶ 12; *see* D.I. 179, Ex. G (McNamara's text messages to Storms, stating "I also think your boxes may have some benefits vs the ones we are doing with JB driver. Lots of stuff to collaborate on. . . . Storms, can you send me those box design specs please! . . . Also, have you ever looked at building a GPU box?"). This exchange corroborates Storms' testimony that

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to the evidence that would be offered to prove a significant contribution to the conception of the invention that is required for a claim of joint inventorship. Lancium does not dispute the overlap in evidence, and in fact cites to the section of its brief arguing that the record is devoid of any evidence that Storms conceived of the entire claimed invention (i.e., the sole inventorship claim) in support of its contention that Storms made no significant contribution to warrant a finding of joint inventorship. D.I. 149 at 30. As such, the Court will not reiterate the genuine issues of material fact that exist related to Storms' conception of the subject matter claimed in the '433 patent. *See supra* Section III.A.

McNamara showed interest in BearBox's technology and believed that Storms may be valuable to McNamara's ongoing and future projects. D.I. 179, Ex. E at 95:12-110:6; 114:7-11 (Storms testifying that McNamara was interested in BearBox's technology during their dinner conversation). Also, it is undisputed that Storms responded to McNamara's texts by emailing McNamara five attachments, including the Product Details document and a proprietary .CSV file, which disputedly demonstrates Storms' conception of the claimed inventions of the '433 patent. D.I. 150 at ¶ 17; D.I. 177 at ¶ 17; D.I. 179, Ex. B; *see also supra* Section III.A. Despite the fact that the parties did not physically work on the invention together, Storms and McNamara plainly had an "open line of communication . . . in temporal proximity to their inventive efforts." *Eli Lilly & Co.*, 376 F.3d at 1359; *see also CODA Dev. S.R.O. v. Goodyear Tire & Rubber Co.*, 916 F.3d 1350, 1359-60 (Fed. Cir. 2019). Moreover, there is a genuine dispute as to whether the .CSV file emailed to McNamara, and later forwarded to Cline, was incorporated or implemented, in part or in whole, into the claimed invention of the '433 patent. *See* D.I. 179, Ex. H at 139-150 (Cline testifying that when the .CSV file was forwarded to him, he understood the column headers, numerical values, and their respective mathematical relationships).

Lancium's reliance on *Rubin v. General Hospital Corp.*, 2011 WL 1625024 (D. Mass. Apr. 28, 2011), to cast doubt on the collaboration is misplaced. D.I. 195 at 16-17. In *Rubin*, the purported joint inventors and named inventors never had any direct communication. *Id.* at *2, *6. To show collaboration, the purported joint inventors relied on their awareness of the named inventors' research and their claim that one of the named inventors read their journal abstract. *Id.* at *6. However, the Court found this evidence insufficient to establish collaboration, noting that the purported joint inventors filed their own provisional patent application after the alleged collaboration without including the named inventors. *Id.* at *7. From this, the Court inferred that

the purported joint inventors did not consider themselves to be collaborating with the named inventors. *Id.* In the present case, however, the Court cannot conclude that no reasonable fact finder could find that there is clear and convincing evidence establishing collaboration between Storms and McNamara based on the following communications: (1) Storms and McNamara's dinner conversation after the Fidelity FCAT Mining Summit—to which the parties dispute the extent of what information regarding BearBox's technology, if any, was shared, *see, e.g.*, D.I. 150 at ¶ 11; D.I. 177 at ¶ 11; D.I. 179, Ex. E at 95:12-114:11; D.I. 179, Ex. F at 133-135; (2) Storms and McNamara's exchange of text messages from May 3 to May 9, 2019, where McNamara undisputedly solicited information about BearBox's product, *see, e.g.*, D.I. 150 at ¶ 12; D.I. 177 at ¶ 12; D.I. 179, Ex. G; and (3) responsive to McNamara's solicitation, Storms sent an email to McNamara with five attachments including the Product Details document and the proprietary .CSV file, *see, e.g.*, D.I. 150 at ¶ 17; D.I. 177 at ¶ 17; D.I. 179, Ex. B.

Finally, Lancium's assertion that the public availability of four of the five attachments emailed to McNamara precludes a finding of collaboration is based on a selective interpretation of *Univ. of Utah v. Max-Planck-Gesellschaft zur Foerderung der Wissenschaften e.V.*, 851 F.3d 1317 (Fed. Cir. 2017). *See* D.I. 149 at 25-26. In *Univ. of Utah*, the Federal Circuit agreed with the district court's finding that a published article, which was prior art to the claimed inventions, "could not, on its own, support a finding of collaboration." 851 F.3d at 1321. However, and contrary to Lancium's proposition, the Federal Circuit—just three paragraphs later—reiterated that "one inventor seeing a relevant report and building upon it might be an element of joint behavior supporting collaboration." *Id.* at 1321-22 (citing *Kimberly-Clark*, 973 F.2d at 917). Therefore, the public nature of a document does not, by itself, preclude a finding of collaboration. *See Dana-Farber Cancer Inst., Inc. v. Ono Pharm. Co.*, 964 F.3d 1365, 1371-72 (Fed. Cir. 2020), *cert.*

denied, 141 S. Ct. 2691 (2021) ("Inventorship of a complex invention may depend on partial contributions to conception over time, and there is no principled reason to discount genuine contributions made by collaborators because portions of that work were published prior to conception for the benefit of the public."). Because there are genuine issues of material fact surrounding the extent of Storms, McNamara, and Cline's collaboration related to the subject matter claimed in the '433 patent, Lancium's Motion as to BearBox's joint inventorship claim is denied.

C. Conversion

1. Statute of Limitations

Lancium moves for summary judgment of BearBox's conversion claim, arguing that the claim is barred by Louisiana's one year statute of limitations. D.I. 149 at 30-33. Specifically, Lancium contends that BearBox's currently pled conversion claim, which was brought with its Second Amended Complaint filed on February 16, 2022, falls outside the one-year prescriptive period because BearBox purportedly admits that it became aware of Lancium's conversion on August 17, 2020, when BearBox reviewed the Lancium-Layer1 lawsuit. *Id.*; D.I. 195 at 18-19. Thus, Lancium argues that BearBox knew, or at a minimum, should have known, of Lancium's conversion because the Lancium-Layer1 lawsuit explains Lancium's method of arbitraging power to maximize profitability, which is allegedly identical to the conduct underlying the currently pled conversion claim. *See, e.g.*, D.I. 149 at 32; D.I. 195 at 18-19. Further, Lancium argues that BearBox's operative conversion claim cannot benefit from the Original Complaint's April 14, 2021 filing date (D.I. 1), thereby evading the one-year statute of limitations, because the currently pled conversion claim does not relate back to the originally pled conversion claim. *Id.*

BearBox vehemently disagrees. First, BearBox maintains that its conversion claim has been consistently pled as arising out of Lancium's alleged deceptive inducement of BearBox's

power arbitrage method under the guise of a potential business relationship through Storms and McNamara's communications in May 2019. D.I. 176 at 31. Thus, BearBox argues its currently pled conversion claim relates back to the date of the Original Complaint, thereby overcoming the statute of limitations. *Id.* at 31-32. Second, BearBox argues that, even if the currently pled conversion claim does not relate back to the Original Complaint, it is not barred by the one-year statute of limitations because BearBox did not learn of Lancium's theft of its specific energy arbitrage method until December 20, 2021, during Lancium's document production. *Id.* at 32-33. In support of this alternative argument, BearBox contends that the Lancium-Layer1 lawsuit does not even use the word "breakeven," and only explains "a high-level description of the bare concept of energy arbitrage" instead of disclosing, as Lancium contends, the particular arbitrage method at issue in this case. *Id.* In fact, BearBox asserts that Lancium's own expert, Dr. Siddiqui, opines that it is impossible to know how specific energy arbitrage methods are used without access to direct evidence of the actual arbitrage method. D.I. 176 at 33; D.I. 179, Ex. W at 34. Thus, BearBox argues that simply reading the Lancium-Layer1 lawsuit could not serve as actual or constructive knowledge sufficient to commence the one-year statute of limitations. *Id.*

Under Louisiana law,[3] "[a] conversion action sounds in tort and is subject to a one-year liberative prescriptive period." *Bihm v. Deca Sys., Inc.*, 226 So. 3d 466, 280 (La. App. 1st Cir. 2017) (citing LA. CIV. CODE ANN. art. 3492). Generally, the prescriptive period begins "to run from the day injury or damage is sustained." LA. CIV. CODE ANN. art. 3492. The injured party need not have actual knowledge of facts that would entitle him to bring a suit. *Bihm*, 226 So. 3d at 480 (citing *Gallant Investments, Ltd. v. Illinois Cent. R. Co.*, 7 So.3d 12, 19 (La. App. 1st Cir.

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[3] Neither party disputes that Louisiana law applies to BearBox's conversion claim. *See* D.I. 92 at 5 n.4.

2009)). Rather, notice sufficient "to excite attention and put the party on guard or call for inquiry"—referred to as constructive knowledge—can commence the prescriptive period. *Bihm*, 226 So. 3d at 480; *see also Hogg v. Chevron USA, Inc.*, 45 So.3d 991, 997 (La. 2010).

While claims brought outside the prescriptive period are generally barred, Louisiana explicitly grants amended claims that "relate back" to the original claim the benefit of the originally pleading's filing date. *Clark v. E. Baton Rouge Par. Dep't of Pub. Works*, 196 So. 3d 142, 146 (La. App. 1st Cir. 2016) (interpreting LA. CODE CIV. PROC. ANN. art. 1153); *see also* Fed. R. Civ. P. 15(c)(1) (an amendment relates back to the date of the original pleading if the "law that provides the applicable statute of limitations allows relation back."). Pursuant to LA. CODE CIV. PROC. ANN. art. 1153, "an amendment to a [complaint] relates back to the date of filing the original [complaint] when the action or defense asserted in the amended [complaint] arises out of the conduct, transaction, or occurrence set forth or attempted to be set forth in the original pleading." *Clark*, 196 So. 3d at 146. Courts are encouraged to apply the doctrine "liberally and without undue restriction by technical rules, consistent with the principle that prescriptive statutes are to be construed in favor of maintaining rather than barring actions." *Id.*; *see also Winford v. Conerly Corp.*, 897 So.2d 560, 568 (La. 2015). As such, an amended complaint is not prescribed by the statute of limitations "[i]f a comparison of the amended petition to the original petition shows that the original petition gave fair notice of the factual situation out of which the amended petition arises." *Clark*, 196 So. 3d at 146 (citing *Reese v. State Dep't of Pub. Safety and Corrections*, 866 So.2d 244, 248 (La. 2004)).

A relation back analysis requires comparing the originally pled claim with the currently pled claim. *Clark*, 196 So. 3d at 146. BearBox's original conversion claim sought recovery for "Defendants induc[ing] the Plaintiffs to disclose the BearBox Technology to them under the guise

of a possible business deal," which allegedly began in May 2019 through a meeting between the two parties, followed by subsequent communications through email and text. *See* D.I. 1 at ¶¶ 3-4, 32-36. The Original Complaint defined "BearBox technology" as:

> an energy-efficient cryptocurrency mining system and related methods that reduce the inefficiency and environmental impact of energy-expensive mining operations by better utilizing available energy resources to increase stability of the energy grid, minimize a mining operation's impact on peak-demand, and also alleviate electricity undersupply and/or oversupply conditions . . . [which] can be used to mine cryptocurrency, such as Bitcoin.

D.I. 1 at ¶ 2. BearBox's currently pled conversion claim seeks recovery for Lancium deceptively inducing BearBox to disclose BearBox's "system designs, documents, data, and know-how" under the guise of a business deal in May 2019. D.I. 103 at ¶¶ 3, 89.

The factual connexity between the original conversion claim and the currently pled conversion claim is readily apparent on the face of the pleadings. Both claims seek recovery for the damages resulting from Lancium's alleged deceptive conduct and theft in May 2019. *Compare* D.I. 1 at ¶¶ 32-36, *with* D.I. 103 at ¶ 89. While BearBox's currently pled conversion claim expands on both the technology purportedly converted, i.e., "system designs, documents, data, and know-how," and Lancium's conduct after the alleged conversion, i.e., using such converted technology to modify Lancium's Smart Response™ software, these amendments do not disturb the relation back doctrine because they only serve to elaborate on the facts supporting the underlying theory of conversion. D.I. 103 at ¶¶ 2, 87, 89. That is to say, the conduct supporting the original conversion claim is identical to the conduct supporting the currently pled conversion claim, regardless of the level of specificity the Second Amended Complaint provides. *Tiller v. Atl. Coast Line R. Co.*, 323 U.S. 574, 581 (1945) (the original pleading and the amended pleading "relate to the same general conduct . . . the cause of action now, as it was in the beginning, is the same.").

Furthermore, the Court is not persuaded by Lancium's assertion that BearBox's own admissions are fatal to finding that the currently pled conversion claim relates back to the original claim. D.I. 149 at 33. As an initial matter, Lancium's selective citation to BearBox's counsel's statement that the Original Complaint "had nothing to do with energy value arbitrage methods" omits a key consideration—BearBox's counsel was distinguishing between the first Complaint's underlying trade secret, i.e., system architecture, and the proposed amendment supporting BearBox's new trade secret claims. *See* D.I. 151, Ex. 22 at 22:16-24:6. And even if BearBox counsel's characterization of the facts underlying each complaint differ, Lancium's conclusion ignores that the conduct underlying the currently pled conversion claim is identical to the conduct pled in the original conversion claim—the deceptive inducement of BearBox's methods and systems through Storms and McNamara's May 2019 communications. Such a rigid comparison of the two conversion claims, as Lancium proffers, is contrary to the general principle that LA. CODE CIV. PROC. ANN. art. 1153 should be liberally construed to do substantial justice. *Reese*, 866 So.2d at 249. As such, the original conversion claim was sufficient to put Lancium on notice that BearBox was seeking recovery for conversion of its technology in May 2019. The currently pled conversion claim created no surprise or prejudice to Lancium, and merely clarified the facts supporting its theory of conversion, including the specific property converted and Lancium's incorporation of the converted property into its Smart Response™ software—all facts which BearBox contends were only brought to light during discovery, which led BearBox to promptly amend its conversion claim. *See* D.I. 176 at 31.

BearBox's currently pled conversion claim can therefore benefit from the Original Complaint's April 14, 2021 filing date. Therefore, it follows that BearBox's currently pled conversion claim was brought within the prescribed one-year statute of limitations. Because the

Court finds that the currently pled conversion claim was brought within the prescribed one-year statute of limitations, the Court need not address Lancium's argument that BearBox knew, or should have known, of the alleged conversion based on BearBox's August 17, 2020 review of the Lancium-Layer1 lawsuit.

2. Preemption Under Federal Patent Law

Separately, Lancium moves for summary judgment of BearBox's conversion claim on the ground that the conversion claim is preempted by federal patent law. *See* D.I. 149 at 33-36. The Court agrees.

Under the Supremacy Clause, state law that conflicts with federal law is without effect. U.S. Const. art. VI, cl. 2; *see, e.g.*, *Bonito Boats v. Thunder Craft Boats*, 489 U.S. 141, 168 (1989); *Hunter Douglas, Inc. v. Harmonic Design, Inc.*, 153 F.3d 1318, 1331 (Fed. Cir. 1998), *overruled in part on other grounds by Midwest Indus. v. Karavan Trailers, Inc.*, 175 F.3d 1356 (Fed. Cir. 1999). Preemption can take one of three unique forms: explicit, field, or conflict preemption. *See Hunter Douglas*, 153 F.3d at 1332. Because federal patent law does not provide explicit preemption, *see, e.g.*, 35 U.S.C. §§ 1–376; *Hunter Douglas*, 153 F.3d at 1332, and because Congress does not intend to exclusively occupy the field of conversion law, this case solely concerns conflict preemption. Conflict preemption occurs when state law "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress." *Aronson v. Quick Point Pencil Co.*, 440 U.S. 257, 262 (1979) (quoting *Hines v. Davidowitz*, 312 U.S. 52, 67 (1941)) (internal quotations omitted).

Federal law preempts state law that offers "patent-like protection" to discoveries unprotected under federal patent law. *Bonito Boats*, 489 U.S. at 156. Federal patent law reflects the objectives of Congress, which includes: (1) "seek[ing] to foster and reward invention"; (2) "promot[ing] disclosure of inventions to stimulate further innovation and to permit the public to

practice the invention once the patent expires"; (3) promoting "the stringent requirements for patent protection . . . to assure that ideas in the public domain remain there for the free use of the public," *Aronson*, 440 U.S. at 262 (citing *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470, 480-81 (1974)); (4) providing a "clear federal demarcation between public and private property"; and (5) promoting "nationwide uniformity in patent law." *Bonito Boats*, 489 U.S. at 162-63. A state cause of action that frustrates these objectives is preempted. *Id.* at 156-57; *Aronson*, 440 U.S. at 262.

In the specific context of a conversion claim, courts have differentiated between claims that are dependent on a determination of patent inventorship or ownership and those that are based on a non-patent theory of conversion. Claims that are dependent on a determination of patent inventorship or ownership, such as a misappropriation of patent rights, are generally preempted by federal patent law. *See Smith v. Healy*, 744 F. Supp. 2d 1112, 1130 (D. Or. 2010) ("Plaintiffs' proposed conversion claim does not concern Plaintiffs' tangible property but rather their intangible idea . . . therefore . . . Plaintiffs' proposed conversion claim would be preempted by [federal] patent law."). In contrast, claims that can be established without reference to patent inventorship or ownership are generally not preempted by federal patent law. *See HIF Bio, Inc. v. Yung Shin Pharms. Industrial Co.*, 600 F.3d 1347, 1354 (Fed. Cir. 2010) (suggesting that plaintiffs could establish a conversion claim not preempted by federal law by basing their claim on defendants' alleged misappropriation of experiments, experimental data, and non-public drafts of papers).

BearBox's conversion claim begins by incorporating by reference the allegations from BearBox's correction of inventorship claims. D.I. 103 at ¶ 84. BearBox then explains how Lancium's "unlawful exercise of dominion over confidential BearBox technology, including system designs, documents, data, and know-how not otherwise found to be a trade secret, or having value beyond the value of the trade secret(s), has permanently interfered with [BearBox's] valuable

property rights." D.I. 103 at ¶ 88. Finally, BearBox outlines that it "[has] suffered and will continue to suffer damages and other financial harms" because Lancium "[has] not compensated or recognized [BearBox] for the use of BearBox's technology." D.I. 103 at ¶¶ 89-90.

By its wording, it is clear that BearBox's conversion claim is "patent-like" in nature and also turns on a determination of inventorship regarding the subject matter of the '433 patent. *See Smith*, 744 F. Supp. 2d at 1130. Although conversion under Louisiana law does not necessarily implicate patent law, the theory underlying BearBox's conversion claim—the theft of BearBox's system designs, documents, data, and know-how which was integrated and monetized by Lancium through its Smart Response™ software, without compensating or recognizing BearBox—seeks protection and remedial compensation for the alleged misappropriation of BearBox's novel ideas. D.I. 103 at ¶ 89. In other words, BearBox's claim that Lancium "has permanently interfered with [BearBox's] valuable property rights" by misappropriating BearBox's technology is a second bite of the apple to correct inventorship if the Court were to find that Storms is neither a sole nor joint inventor of the '433 patent.

BearBox's attempt to differentiate its conversion claim as relying on a non-patent theory of recovery is unsuccessful. While the Court recognizes that BearBox amended its pleading to allege that "[n]ot all aspects of BearBox's technology that was stolen and used by Defendants was described and claimed in the '433 Patent," *see* D.I. 103 at ¶ 46, this allegation cannot serve as the basis for a non-patent theory of recovery. This is because BearBox's own expert, Dr. McClellan, concedes that regardless of whether the '433 patent actually discloses BearBox's power arbitrage method, BearBox is barred from using its power arbitrage method because it may likely infringe the '433 patent. *See* D.I. 196-1, Ex. 30 at 231:10-232:1. Stated another way, the alleged converted property is described and disclosed in the '433 patent. *See id.* at 231:18-232:1 ("If [Storms] were

to use his [power arbitrage method], it might be infringing the ['433] patent anyway. Even if he used his system—because the arbitrage adds onto the capabilities disclosed in the patent. It adds some things onto that aren't specifically disclosed in the patent, but they're hinted at. . . . even if you implemented a system like this, . . . you may end up infringing the patent regardless."). Further, BearBox's attempt to reconcile its conversion claim as a non-patent theory of recovery is further belied by its own arguments and headings in its Answering Brief. For example, BearBox's heading stating that "Lancium filed the '433 patent to monopolize Storms' portions of the system that Storms communicated to it," *see* D.I. 176 at 12, supports the reasonable conclusion that all the communications sent to Lancium served as the foundation for the '433 patent. This contradicts BearBox's own assertion that not everything communicated, and therefore converted, served as the basis for the '433 patent. *See* D.I. 103 at ¶ 46. The Court's conclusion is also supported by the fact that BearBox's conversion claim begins by incorporating by reference its inventorship claims. D.I. 103 at 84.

That BearBox's conversion claim seeks to recover patent-like damages further supports that it is preempted by federal patent law. There is no dispute that, under Louisiana law, "[t]he measure of damages for wrongful conversion is the return of the property, or if it cannot be returned, the value of the property at the time of conversion." *Capers v. NorthPro Properties Mgmt, LLC*, 321 So. 3d 502, 514 (La. App. 2d Cir. 2021). However, rather than solely demand the return of its allegedly converted property, BearBox repeatedly pursues monetary damages akin to a royalty-like payment. D.I. 103 at ¶¶ 6, 89, "Prayer for Relief" at ¶ G. BearBox's Second Amended Complaint is also replete with assertions advancing the theme that BearBox is entitled to monetary damages because of Lancium's purported failure to compensate or recognize BearBox for the use of BearBox's converted technology. *See, e.g.*, *id.* at ¶ 6 ("Plaintiffs bring this action to

recover damages caused by Defendants' theft and unauthorized use, and subsequent exploitation of Plaintiffs system design, data, documents, and know-how."); *id.* at ¶ 50 ("Defendants have used BearBox's technology, including the stolen system designs, diagrams, data, and know-how, and its subsequently-modified Smart Response™ software . . . to allow Defendants to profit significantly from use, license, sale, and investments related to its modified Smart Response™ software. ***Defendants are not, and have never, been entitled to these profits***.") (emphasis added); *id.* at ¶ 87 ("Without Plaintiffs' consent, Defendants intentionally and willfully assume dominion and control over BearBox's technology, including system designs, documents, data, and know-how, and improperly used it to modify their Smart Response™ software . . . and subsequently used, sold, licensed, and procured investments related to, and otherwise monetized, that software for substantial profit."); *id.* at ¶ 89 ("Despite providing Defendants with the system designs, documents, data, and know-how that allowed Defendants to modify their Smart Response™ software, and corresponding system designs, ***Defendants have not compensated or recognized Plaintiffs for the use of BearBox's technology***. Defendants' actions constitute an improper and unauthorized use of Plaintiffs' property.") (emphasis added); *id.* at 90 ("As a result of Defendants' improper and unauthorized use of Plaintiffs' system designs, documents, data, and know-how to reconstruct and use BearBox's technology, Plaintiffs ***have suffered and will continue to suffer damages and other financial harms*** in an amount to be proven at trial.") (emphasis added).

By these allegations' wording, it is clear that BearBox's damages are predicated on the resolution of inventorship or ownership of the technology disclosed in the '433 patent. That BearBox seeks patent-like damages is further supported by BearBox's own damages expert, David Duski, who both reaffirms that BearBox seeks monetary damages in, effectively, a repackaged form of a royalty payment, and reasserts BearBox's theme that monetary damages are necessary

to compensate or recognize BearBox for use of BearBox's converted technology. D.I. 170, Ex. 25 at 8 ("[T]he value of the Converted Property may be determined by calculating the present value of the future cash flows Lancium expected to receive attributable to the Converted Property at the time of conversion."); *id.* at 14 ("I understand that through the use of the Converted Property, Lancium will be able to craft voluntary reduction and/or bid strategies that ensure maximum profits."); *see, e.g.*, *Speedfit LLC v. Woodway USA, Inc.*, 226 F. Supp. 3d 149, 160 (E.D.N.Y. 2016) (concluding that the plaintiffs' conversion claim was preempted by federal patent law, where plaintiffs' underlying conversion claim sought royalty-like damages that ultimately required a determination of inventorship). Therefore, considering the totality of evidence, BearBox's conversion claim is preempted by federal patent law because the right involved here and compensated for relies on a theory of conversion that is "patent-like" in nature. Lancium's Motion related to BearBox's conversion claim being preempted by federal patent law is granted, and BearBox's conversion claim (Count V) is dismissed with prejudice.

IV. LANCIUM's PENDING MOTIONS

In addition to Lancium's First Motion for Summary Judgment (D.I. 148), Lancium also filed a Second Motion for Summary Judgment Regarding Damages combined with a Motion to Exclude Opinions of David Duski (D.I. 167), and a Motion to Bifurcate BearBox's Patent Inventorship Claims from the Conversion Claims (D.I. 222) (collectively, "Lancium's Pending Motions"). However, as both of Lancium's Pending Motions solely depend on BearBox's conversion claim—which has now been dismissed with prejudice—the Court will deny Lancium's Pending Motions as moot.

The Court will issue an order consistent with this Memorandum Opinion.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR., Defendants.	Civil Action No. 21-534-GBW

ORDER

At Wilmington this 14th day of November, 2022:

For the reasons set forth in the Memorandum Opinion issued this day, **IT IS HEREBY ORDERED** that:

1. Lancium's First Motion for Summary Judgment (D.I. 148) is **GRANTED-IN-PART** and **DENIED-IN-PART**;

2. Count V of BearBox's Second Amended Complaint (D.I. 103) is **DISMISSED WITH PREJUDICE**;

3. Lancium's Second Motion for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski (D.I. 167) is **DENIED AS MOOT**; and

4. Lancium's Motion to Bifurcate BearBox's Patent Inventorship Claims from the Conversion Claims (D.I. 222) is **DENIED AS MOOT**.

Because the Memorandum Opinion is filed under seal, the parties shall meet and confer and, no later than November 23, 2022, submit a joint proposed redacted version, accompanied by a supporting memorandum, detailing how, under applicable law, the Court may approve any

requested redactions. In the absence of a timely, compliant request, the Court will unseal the entire opinion.

GREGORY B. WILLIAMS
UNITED STATES DISTRICT JUDGE

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR., Defendants.	C.A. No. 21-534-GBW **FILED UNDER SEAL**

MEMORANDUM ORDER

At Wilmington, Delaware this 23rd day of November 2022.

Having reviewed the parties' letter briefing and other materials filed with respect to Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline, Jr.'s (collectively, "Lancium") Motion to Strike Plaintiffs BearBox LLC and Austin Storms's (collectively, "BearBox") Supplemental Expert Report of Dr. Stanley McClellan ("Dr. McClellan's Supplemental Report"), IT IS HEREBY ORDERED that Lancium's Motion to Strike (D.I. 236) is **GRANTED** and Dr. McClellan's Supplemental Report is **STRICKEN**.

The Court recognizes that the exclusion of otherwise admissible testimony because of a party's failure to meet a timing requirement is a harsh measure and should be avoided where possible. *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 792 (3d Cir. 1994). "However, sometimes, such exclusion is necessary; fidelity to the constraints of Scheduling Orders and deadlines is critical to the Court's case management responsibilities," because "flouting of discovery deadlines causes substantial harm to the judicial system." *Finch v. Hercules, Inc.*, 1995 WL 785100, at *9 (D .Del. 1995) (internal citations omitted). As a sanction for failure to comply

with the Scheduling Order, the Court has the authority to sanction a party by "prohibiting that party from introducing designated matters in evidence." Fed. R. Civ. P. 37(b).

Courts in the Third Circuit apply the *Pennypack* factors when considering whether to strike an expert report. *See Praxair, Inc. v. ATMI, Inc.*, 231 F.R.D. 457 (D. Del. 2005), *rev'd on other grounds*, 543 F.3d 1306 (Fed. Cir. 2008). The *Pennypack* factors are as follows:

> (1) the prejudice or surprise in fact of the party against whom the evidence would have been presented, (2) the ability of that party to cure the prejudice, (3) the extent to which the presentation of the evidence would disrupt the orderly and efficient trial of the case or other cases in the court, (4) bad faith or willfulness in failing to comply with the court's order, and (5) the importance of the excluded evidence.

LabMD Inc. v. Boback, 47 F.4th 164, 189 (3d Cir. 2022).

Here, the weight of the *Pennypack* factors favor excluding Dr. McClellan's Supplemental Report. At the outset, comparing both Dr. McClellan's Opening Report, *see* D.I. 151-1, Ex. 3, and his Reply Report, *see id.* at Ex. 4, with Dr. McClellan's Supplemental Report, it is clear that Dr. McClellan is offering new legal theories and opinions related to BearBox's alleged conception and communication of the subject matter of the '433 patent. For example, Dr. McClellan's Supplement Report offers an analysis of how Austin Storms allegedly conceived of a system where the power entity held the option. *See* D.I. 237, Ex. 1 at ¶¶ 25-26. However, Dr. McClellan was previously of the opinion that the load, not the power entity, held the option in a power option agreement. *See* McClellan Dep. Tr. at 157:1-18 (testifying that the plain and ordinary meaning of "power option agreement" is "opting to purchase power ahead of time at a certain rate . . . I'm going to pay for that power, that's the option."). Although Dr. McClellan contends that his understanding of the claim terms is consistent with the Court's adopted construction, *see* D.I. 237, Ex. 1 at ¶ 6, this subtle distinction supplies the justification Dr. McClellan relies upon when advancing the new

theory that the "power entity associated with the delivery of power to a load" is depicted as "generation assets" in the diagram communicated by BearBox to Lancium. *See id.* at ¶¶ 25-26.

Further, Dr. McClellan offers a new opinion related to "minimum power threshold" and what is required of the load. *See id.* at ¶¶ 24-26. Specifically, Dr. McClellan's Supplemental Report now applies "consume" and "use" interchangeably—although he previously opined that a load was not required to use the "minimum power threshold," *see* D.I. 151, Ex. 5 at 84:18-85:1—and further states that BearBox's system "was designed for the miners to receive instructions to consume, or use, a fixed amount of energy by mining Bitcoin" unless otherwise instructed. *See* D.I. 237, Ex. 1 at ¶¶ 25-26. But, neither Dr. McClellan's Opening Report nor his Reply Report explain how BearBox's system operated by maintaining "a minimum amount of power a load must use during an associated time interval" (i.e., "minimum power threshold") as defined by the power option agreement. While a comparison of an expert's reports does not require "verbatim consistency," *see Dow Chem. Co. v. Nova Chemicals Corp. (Canada)*, 2010 WL 2044931, at *2 (D. Del. May 20, 2010) (quoting *Power Integrations, Inc. v. Fairchild Semiconductor Int'l, Inc.*, 585 F. Supp. 2d 568, 581 (D. Del. 2008)), Dr. McClellan's opinions in his Supplemental Report are beyond mere "elaboration" or "clarification." Instead, Dr. McClellan advances untimely new legal theories and opinions which would ultimately prejudice Lancium, especially at this late juncture of the case.[1]

Beyond offering new opinions, Dr. McClellan's Supplemental Report is untimely. The Court's Scheduling Order requires opening expert reports to be served on April 5, 2022, rebuttal

[1] Even assuming that BearBox was correct that Dr. McClellan's Supplemental Report does not offer new opinions, the Court cannot reasonably conclude that exclusion of that report—which would necessarily reiterate the same opinions proffered in Dr. McClellan's Opening Report and Reply Report—would harm BearBox.

reports be served by May 6, 2022, and reply reports be served by May 20, 2022. *See* D.I. 35. The parties stipulated to extending the expert discovery deadline, which ultimately closed on June 6, 2022. D.I. 109. But it was not until November 11, 2022, nearly three weeks before the start of a three day bench trial, that Dr. McClellan filed his Supplemental Report. *See* D.I. 237 at Ex. 2, Ex. 3. What is more, in contravention of the Court's Scheduling Order, BearBox neither sought leave of the Court or consent from Lancium to serve Dr. McClellan's Supplemental Report. *See id.* at ¶ 7(f)(i) ("No other expert reports will be permitted without either the consent of all parties or leave of the Court."). BearBox's disregard of the express terms of the Court's Scheduling Order indicates bad faith which weighs in favor of exclusion. *See, e.g.*, *Praxair*, 231 F.R.D. at 463-64; *Masimo Corp. v. Philips Elec. North Am. Corp.*, 2013 WL 2178047, at *11-13 (D. Del. May 20, 2013) (recommending striking untimely supplemental expert report), *recommendation adopted by Masimo Corp. v. Philips Elec. North Am. Corp.*, 62 F. Supp. 3d 368, 388-389 (D. Del. 2014).

Additionally, BearBox's proffered excuse that its delay in serving Dr. McClellan's Supplemental Report is the creation of Lancium's untimely request for claim construction is meritless. *See* D.I. 241 at 1-3. Contrary to BearBox's assertion, applying or analyzing the "plain and ordinary" meaning of the disputed terms was evident to BearBox by at least May 2022, when Lancium's expert—Dr. Ehsani—applied the "plain and ordinary" meaning in his rebuttal expert report. *See Praxair*, 231 F.R.D. at 463-64 (excluding defendants' supplemental expert report in part because defendants were aware of plaintiff's differing opinion "months ago when the expert reports were filed."); *see* D.I. 154, Ex. A at ¶¶ 42-43, 107, 109, 116-117. That the Court only recently adopted Lancium's proposed "plain and ordinary" meaning of the disputed terms as the proper construction does not alter the fact that both BearBox and Dr. McClellan were equipped with Lancium's proposed constructions six months prior to supplementing Dr. McClellan's

reports. In fact, Dr. McClellan had an obligation to address Lancium's arguments and analysis related to the plain and ordinary meaning of these disputed terms. *See, e.g.*, *St. Clair Intellectual Prop. Consultants, Inc. v. Matshushita Elec. Indus. Co., Ltd.*, 2012 WL 1015993, at *5 (D. Del. Mar. 26, 2012) ("When claim construction remains an open issue at the time the parties serve expert reports . . . the parties have an obligation 'to prepare for the fact that the court may adopt [the other party's claim] construction.'" (quoting *Union Carbide Chems. & Plastics Tech. Corp. v. Shell Oil Co.*, 270 F. Supp. 2d 519, 524 (D. Del. 2003)). Even more, Dr. McClellan acknowledged that he and Lancium's expert disagreed on the plain and ordinary meaning of the disputed terms, *see* D.I. 151, Ex. 4 at ¶ 86, yet failed to apply or analyze what Lancium's expert considered to be the "plain and ordinary" meaning. *Id.* at ¶ 8.

Finally, because Dr. McClellan's Supplement Report was served on November 11, 2022, and a three day bench trial is set to begin on December 6, 2022, Lancium has no meaningful opportunity to conduct rebuttal discovery, prepare a supplemental rebuttal report, or prepare for an additional deposition. *See, e.g.*, *Praxair*, 231 F.R.D. at 463-64; *Masimo Corp.*, 2013 WL 2178047, at *12; *INVISTA North America S.a.r.l. v. M&G USA Corp.*, 2013 WL 3216109, at *3-4 (D. Del. June 25, 2013). While BearBox's offer to have Dr. Ehsani provide a supplemental report to address Dr. McClellan's Supplemental Report may cure some prejudice, *see* D.I. 243 at 2 n.4, this would undoubtedly disrupt the trial process. Moreover, in light of the approaching Thanksgiving holiday, such a strained schedule exacerbates the potential prejudice.

The risk of prejudice suffered by Lancium is uncurable in light of the strained schedule and quickly approaching trial. Therefore, because the *Pennypack* factors favor exclusion of Dr. McClellan's Supplemental Report, Lancium's Motion to Strike is granted.

WHEREFORE, at Wilmington this 23rd day of November, 2022, **IT IS HEREBY ORDERED** that Lancium's Motion to Strike (D.I. 236) is **GRANTED**, and BearBox's Supplemental Expert Report of Dr. McClellan is **STRICKEN**.

Because the Memorandum Order is filed under seal, the parties shall meet and confer and, no later than November 29, 2022, submit a joint proposed redacted version, accompanied by a supporting memorandum, detailing how, under applicable law, the Court may approve any requested redactions. In the absence of a timely, compliant request, the Court will unseal the entire order.

GREGORY B. WILLIAMS
UNITED STATES DISTRICT JUDGE

8199450

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

January 13, 2022

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THIS OFFICE OF:

PATENT NUMBER: ***10,608,433***
ISSUE DATE: ***March 31, 2020***

By Authority of the
Under Secretary of Commerce for Intellectual Property
and Director of the United States Patent and Trademark Office

Sylvia Holley
Certifying Officer

TX001
BearBox v. Lancium
21-cv-00534

US010608433B1

(12) **United States Patent**
McNamara et al.

(10) **Patent No.: US 10,608,433 B1**
(45) **Date of Patent: Mar. 31, 2020**

(54) **METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT**

(71) Applicant: **Lancium LLC**, Houston, TX (US)

(72) Inventors: **Michael T. McNamara**, Newport Beach, CA (US); **Raymond E. Cline, Jr.**, Houston, TX (US)

(73) Assignee: **Lancium LLC**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/702,931**

(22) Filed: **Dec. 4, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/927,119, filed on Oct. 28, 2019.

(51) **Int. Cl.**
H02J 3/14 (2006.01)
H02J 3/00 (2006.01)
G06F 1/3203 (2019.01)

(52) **U.S. Cl.**
CPC ***H02J 3/14*** (2013.01); ***G06F 1/3203*** (2013.01); ***H02J 3/008*** (2013.01)

(58) **Field of Classification Search**
CPC H02J 3/14; H02J 3/008; G06F 1/3203
See application file for complete search history.

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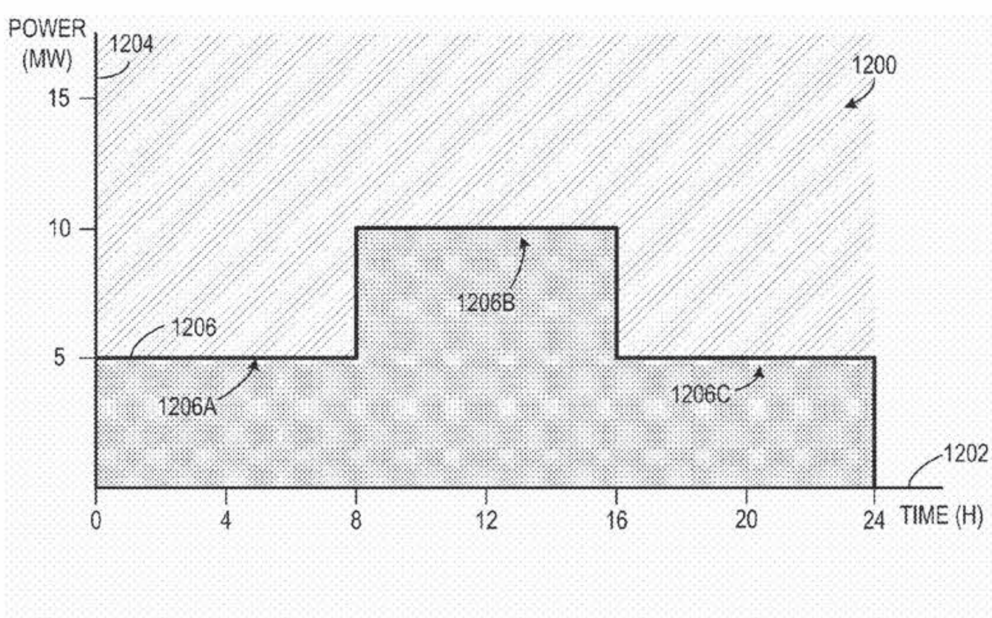
(74) *Attorney, Agent, or Firm* — McDonnell Boehnen Hulbert & Berghoff LLP

(57) **ABSTRACT**

Examples relate to adjusting load power consumption based on a power option agreement. A computing system may receive power option data that is based on a power option agreement and specify minimum power thresholds associated with time intervals. The computing system may determine a performance strategy for a load (e.g., set of computing systems) based on a combination of the power option data and one or more monitored conditions. The performance strategy may specify a power consumption target for the load for each time interval such that each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The computing system may provide instructions the set of computing systems to perform one or more computational operations based on the performance strategy.

20 Claims, 16 Drawing Sheets



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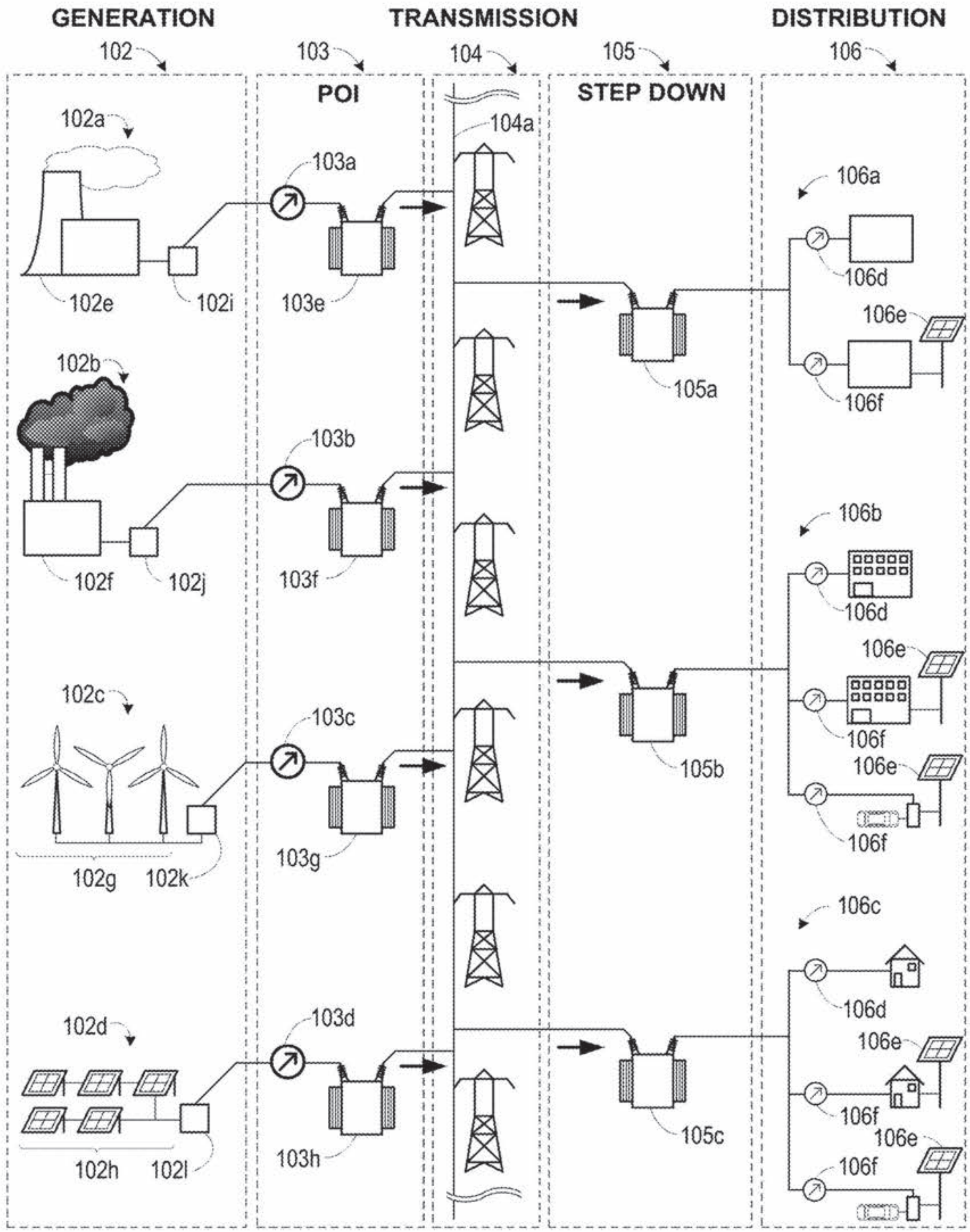

PRIOR ART
FIGURE 1

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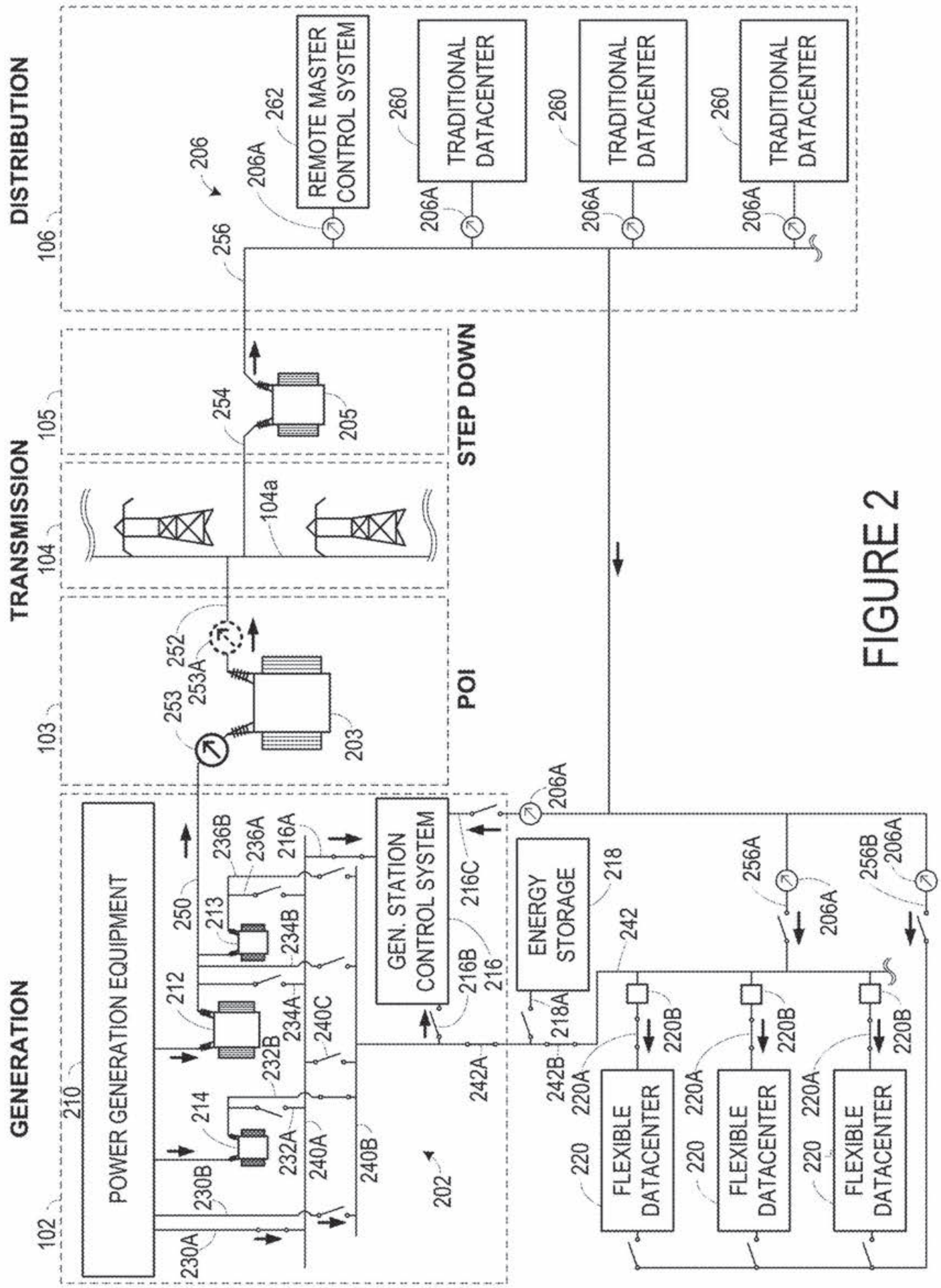


FIGURE 2

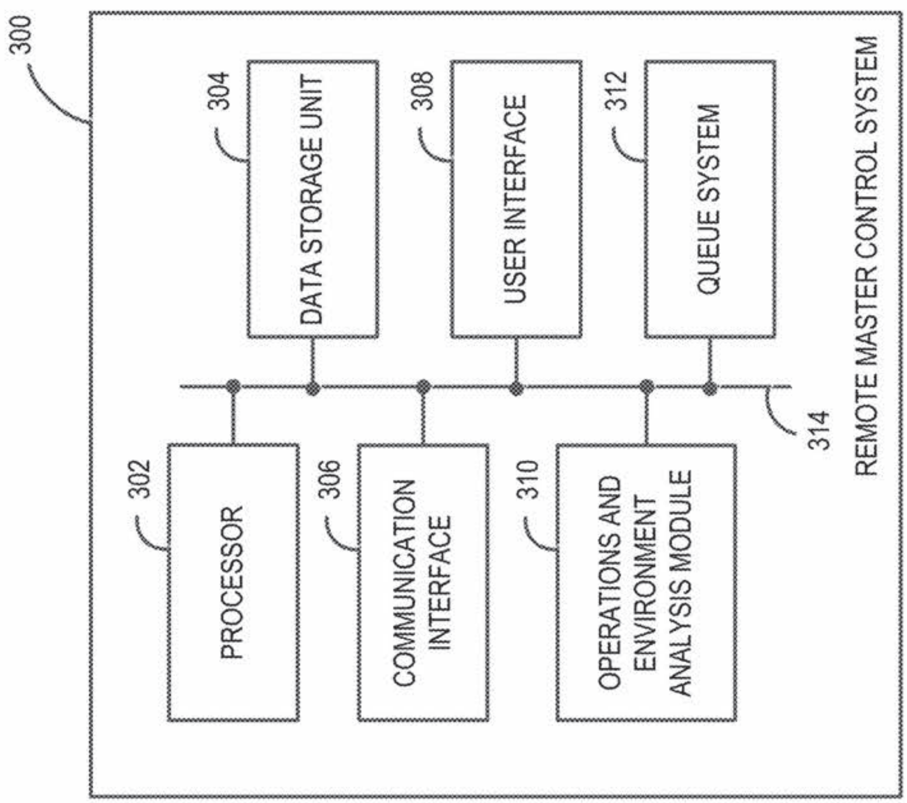

300
304
DATA STORAGE UNIT
308
USER INTERFACE
312
QUEUE SYSTEM
302
PROCESSOR
306
COMMUNICATION INTERFACE
310
OPERATIONS AND ENVIRONMENT ANALYSIS MODULE
314
REMOTE MASTER CONTROL SYSTEM

FIGURE 3

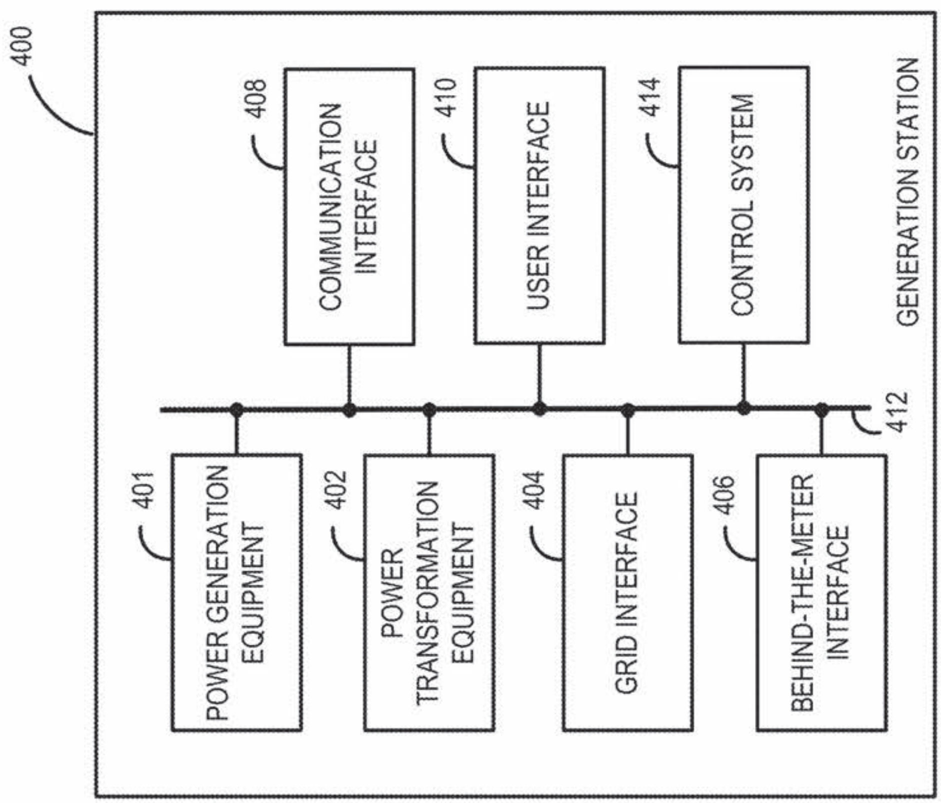

400
GENERATION STATION
408
COMMUNICATION INTERFACE
410
USER INTERFACE
414
CONTROL SYSTEM
412
401
POWER GENERATION EQUIPMENT
402
POWER TRANSFORMATION EQUIPMENT
404
GRID INTERFACE
406
BEHIND-THE-METER INTERFACE

FIGURE 4

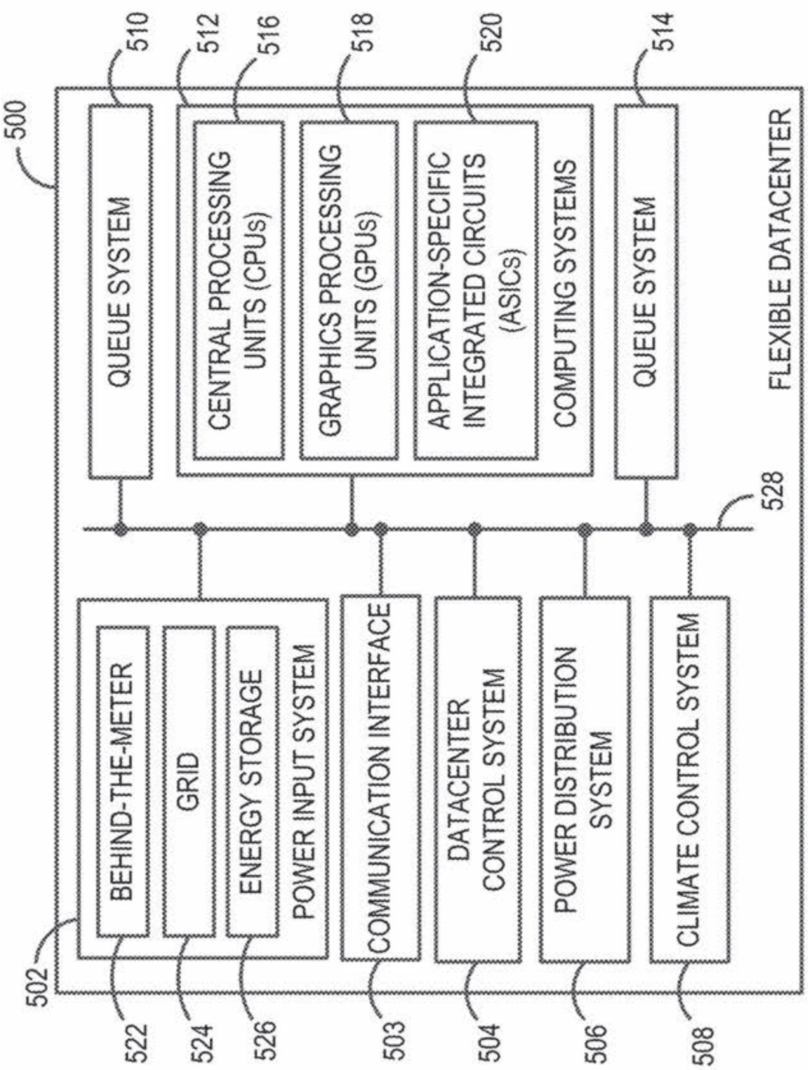

500
510
512
516
518
520
514
QUEUE SYSTEM
CENTRAL PROCESSING UNITS (CPUs)
GRAPHICS PROCESSING UNITS (GPUs)
APPLICATION-SPECIFIC INTEGRATED CIRCUITS (ASICs)
COMPUTING SYSTEMS
QUEUE SYSTEM
FLEXIBLE DATACENTER
528
BEHIND-THE-METER
GRID
ENERGY STORAGE
POWER INPUT SYSTEM
COMMUNICATION INTERFACE
DATACENTER CONTROL SYSTEM
POWER DISTRIBUTION SYSTEM
CLIMATE CONTROL SYSTEM
502
522
524
526
503
504
506
508

FIGURE 5

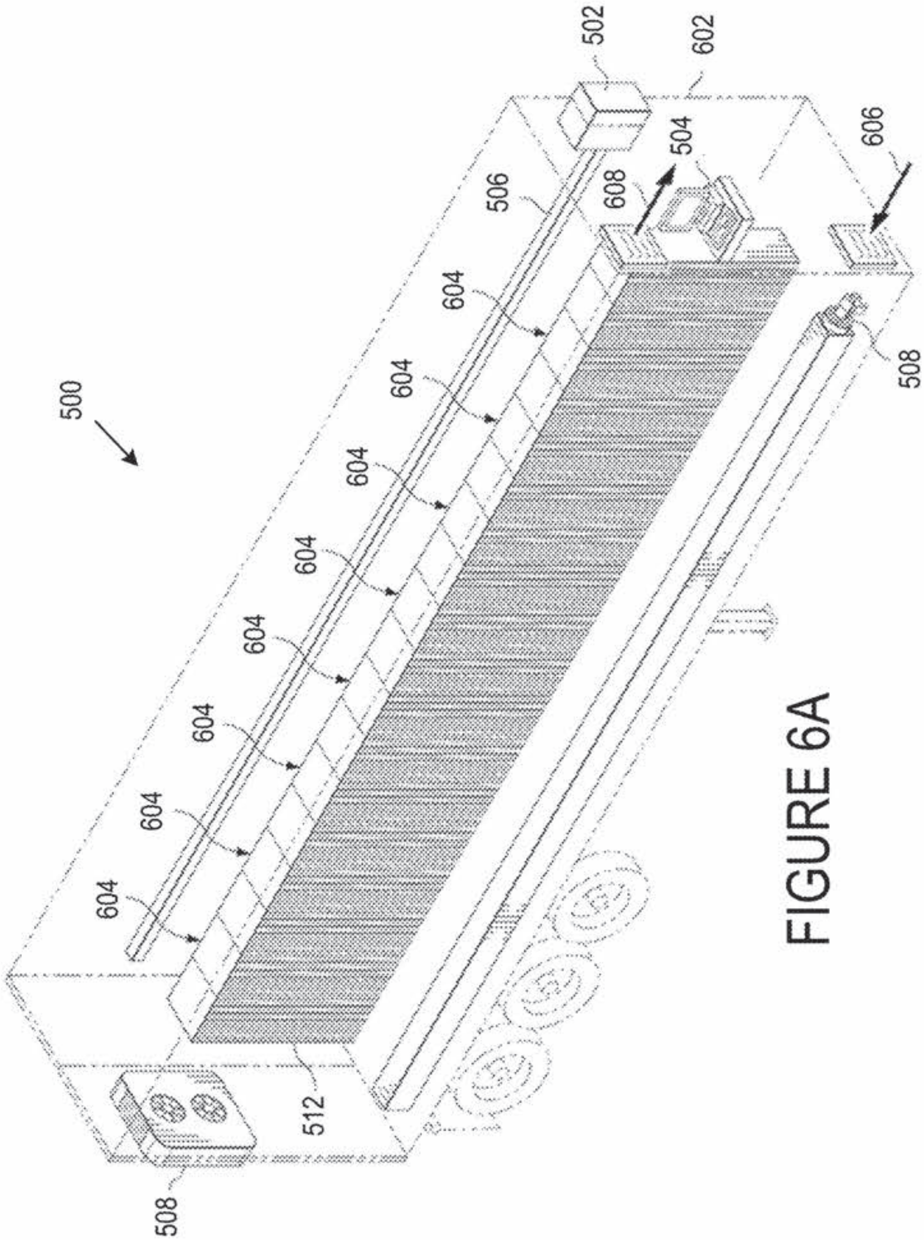

500
502
602
504
506
608
606
604
604
604
604
604
604
604
604
508
512
508

FIGURE 6A

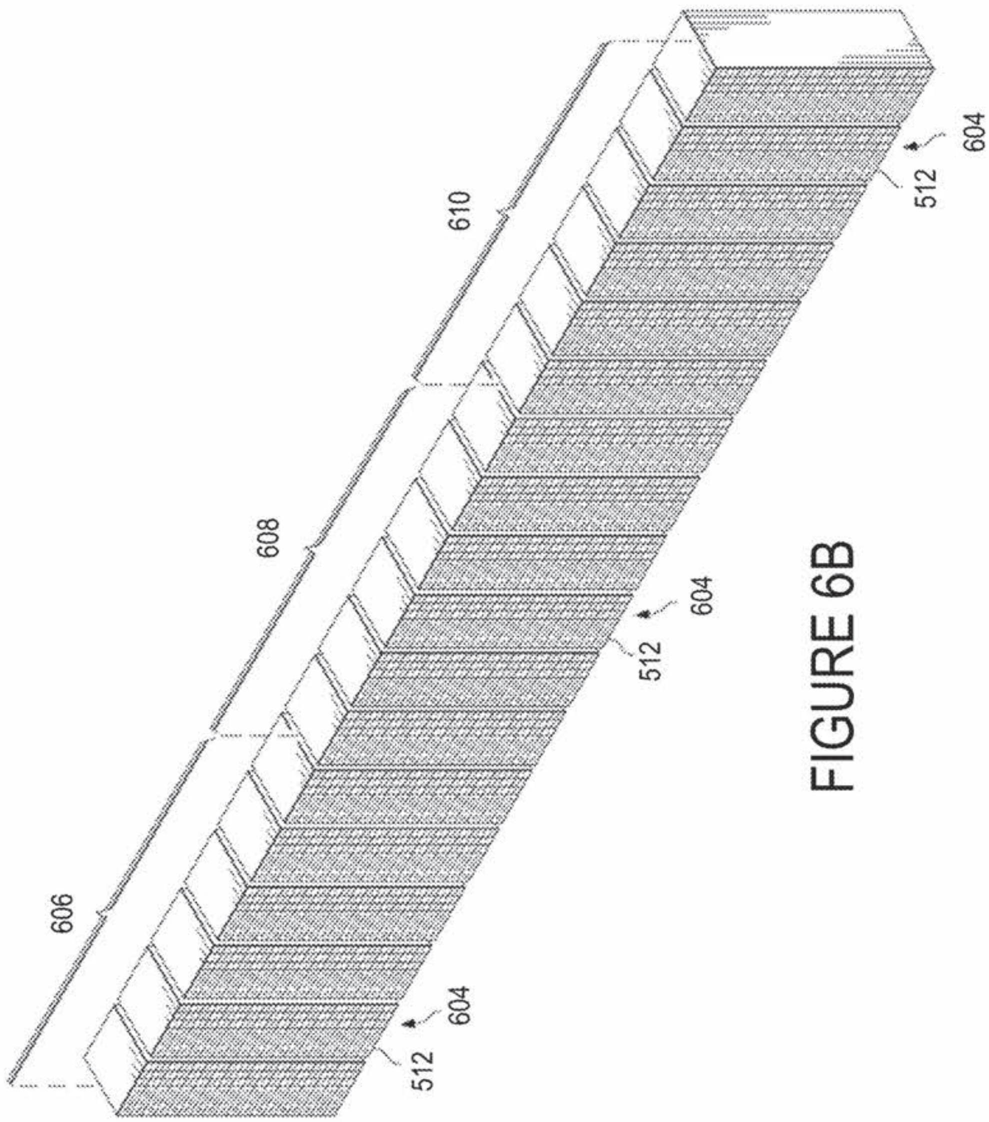


FIGURE 6B

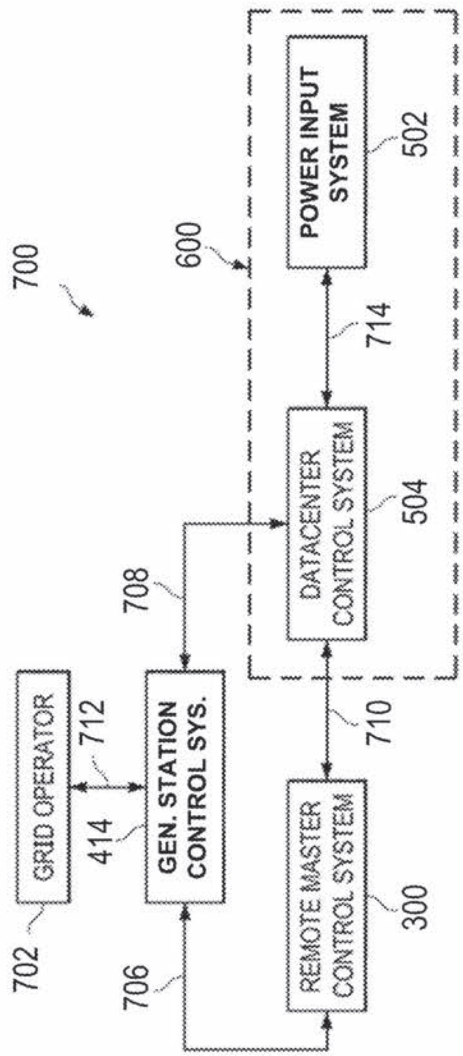
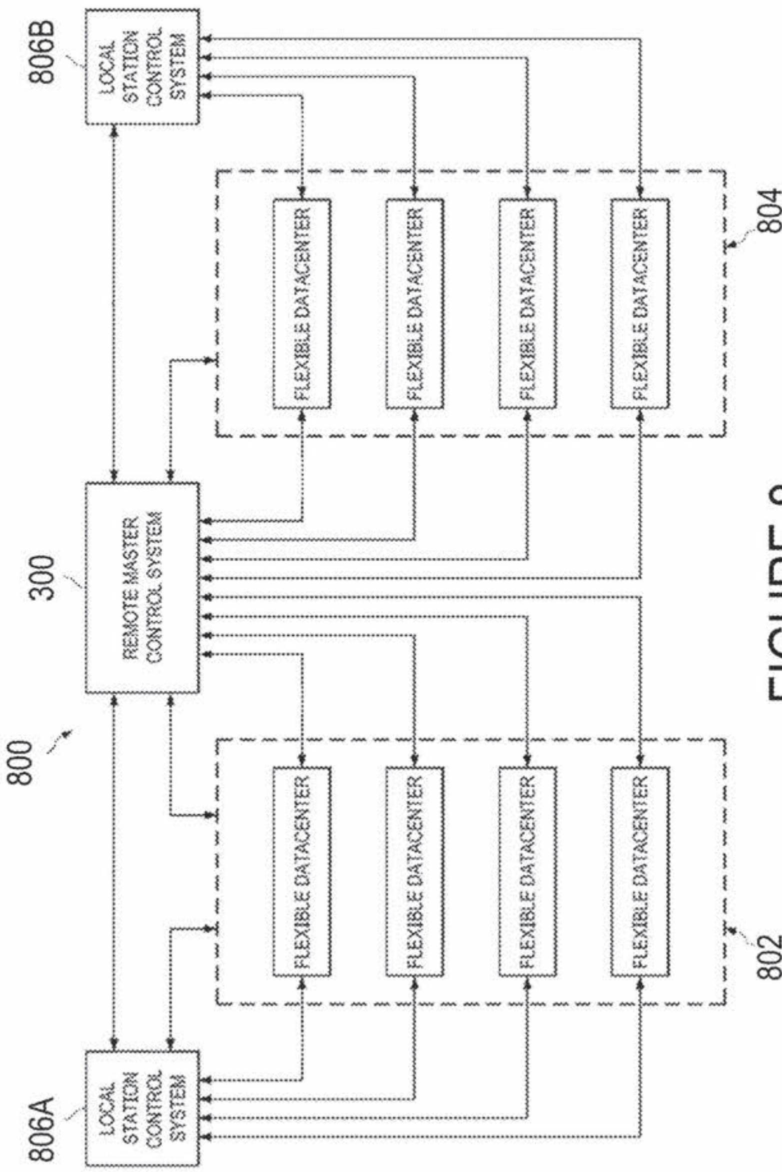

700
600
POWER INPUT SYSTEM
502
714
DATACENTER CONTROL SYSTEM
504
708
710
GRID OPERATOR
702
712
414
GEN. STATION CONTROL SYS.
706
REMOTE MASTER CONTROL SYSTEM
300

FIGURE 7



806B
LOCAL STATION CONTROL SYSTEM
300
REMOTE MASTER CONTROL SYSTEM
800
806A
LOCAL STATION CONTROL SYSTEM
804
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
802
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER

FIGURE 8

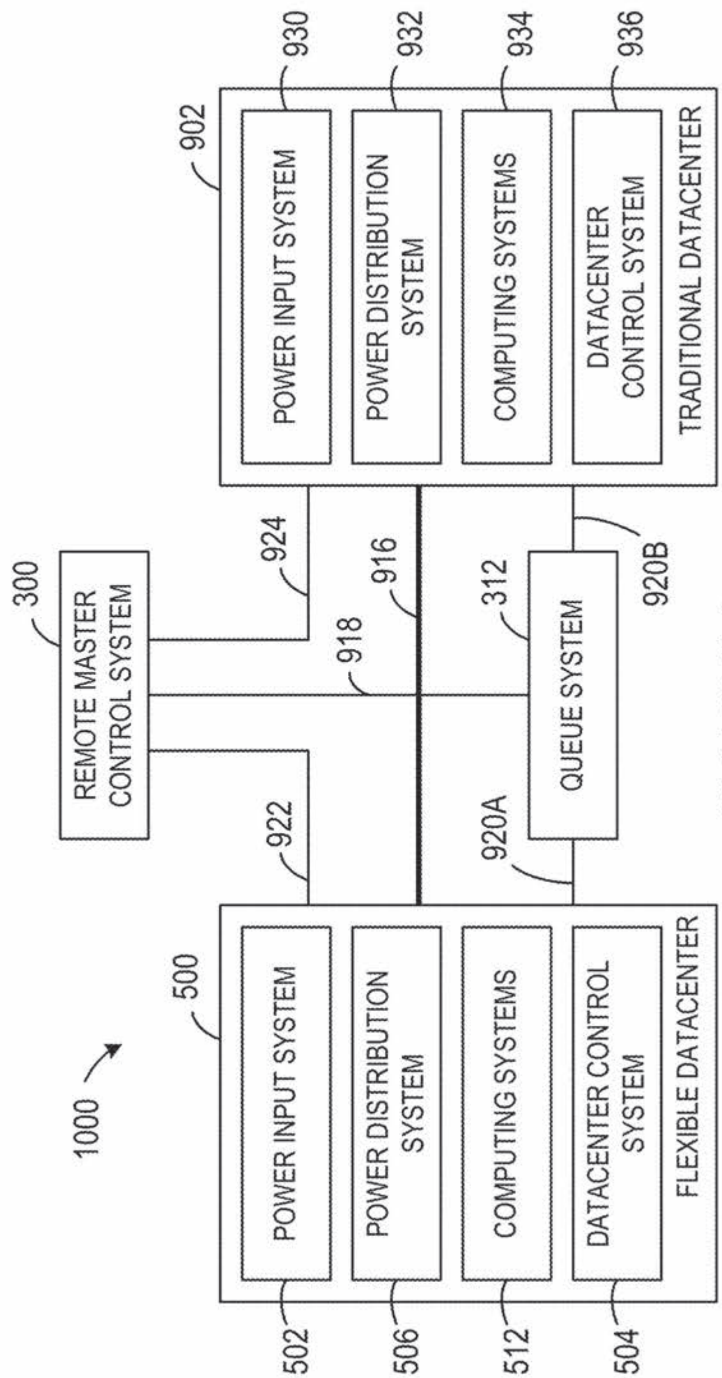

1000
500
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
FLEXIBLE DATACENTER
502
506
512
504
300
REMOTE MASTER CONTROL SYSTEM
922
924
916
918
312
QUEUE SYSTEM
920A
920B
902
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
TRADITIONAL DATACENTER
930
932
934
936

FIGURE 9

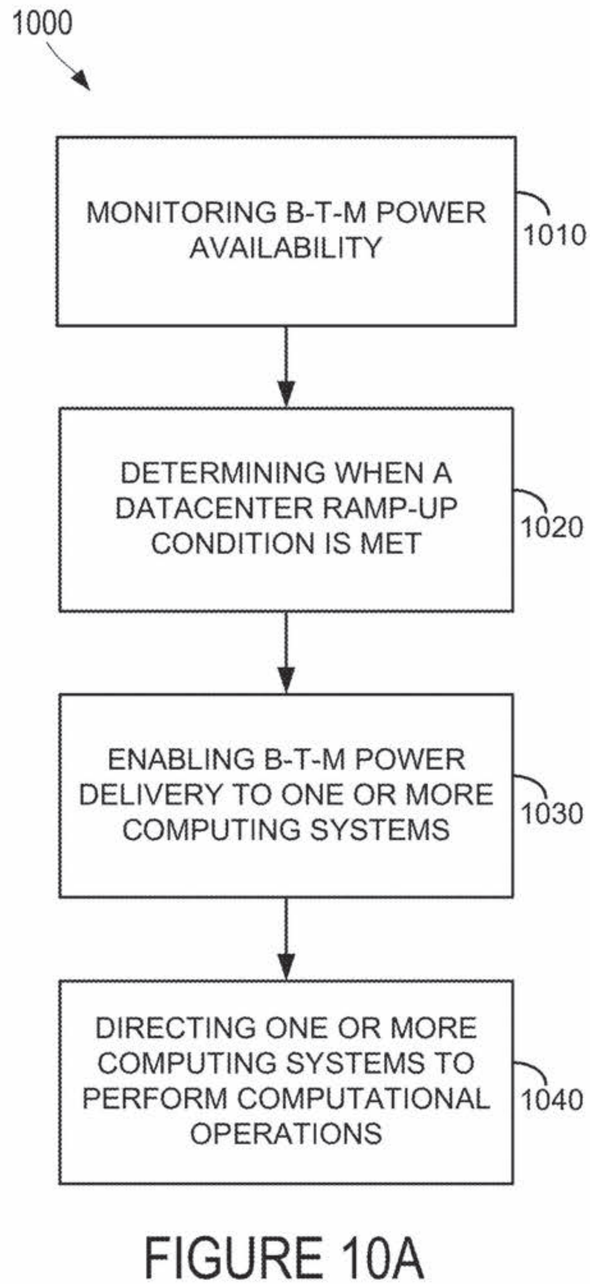

1000
MONITORING B-T-M POWER AVAILABILITY
1010
DETERMINING WHEN A DATACENTER RAMP-UP CONDITION IS MET
1020
ENABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1030
DIRECTING ONE OR MORE COMPUTING SYSTEMS TO PERFORM COMPUTATIONAL OPERATIONS
1040

FIGURE 10A

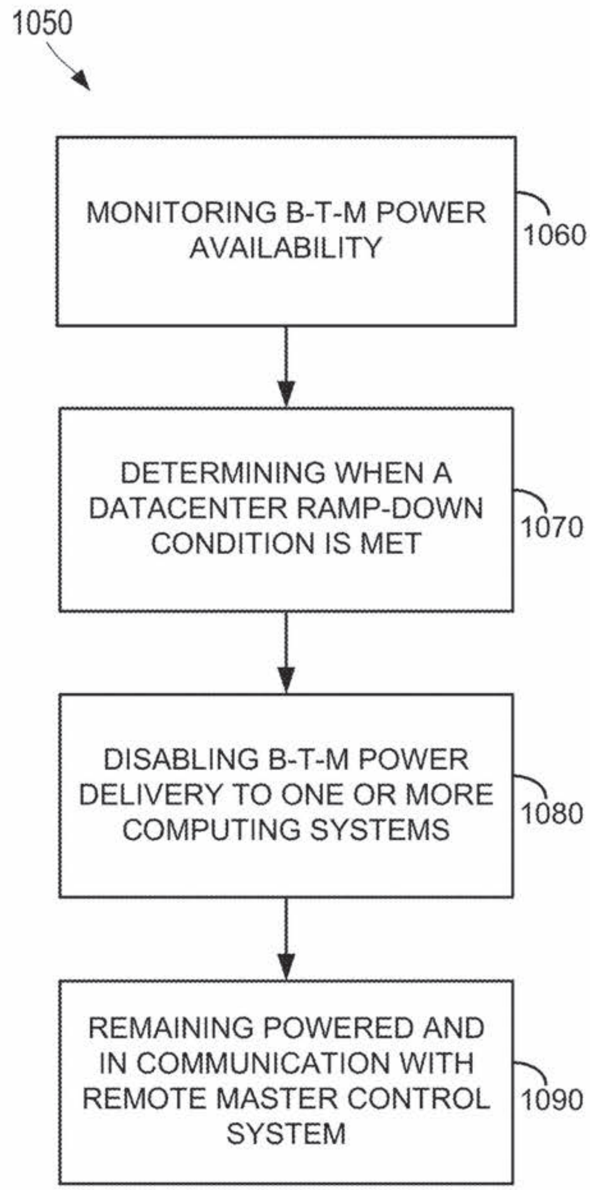

1050
MONITORING B-T-M POWER AVAILABILITY
1060
DETERMINING WHEN A DATACENTER RAMP-DOWN CONDITION IS MET
1070
DISABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1080
REMAINING POWERED AND IN COMMUNICATION WITH REMOTE MASTER CONTROL SYSTEM
1090

FIGURE 10B

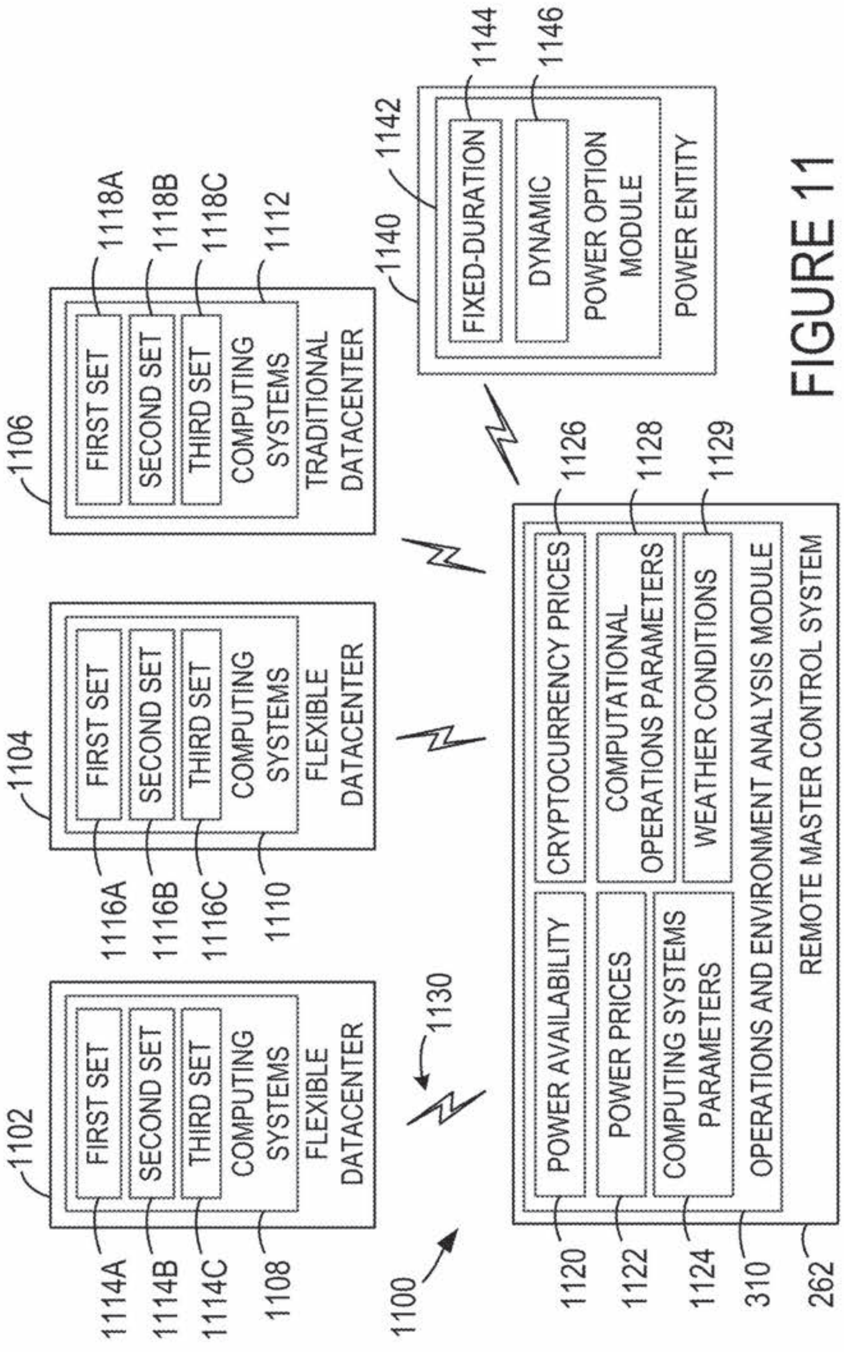


FIGURE 11

BB00001664

TX001.0016

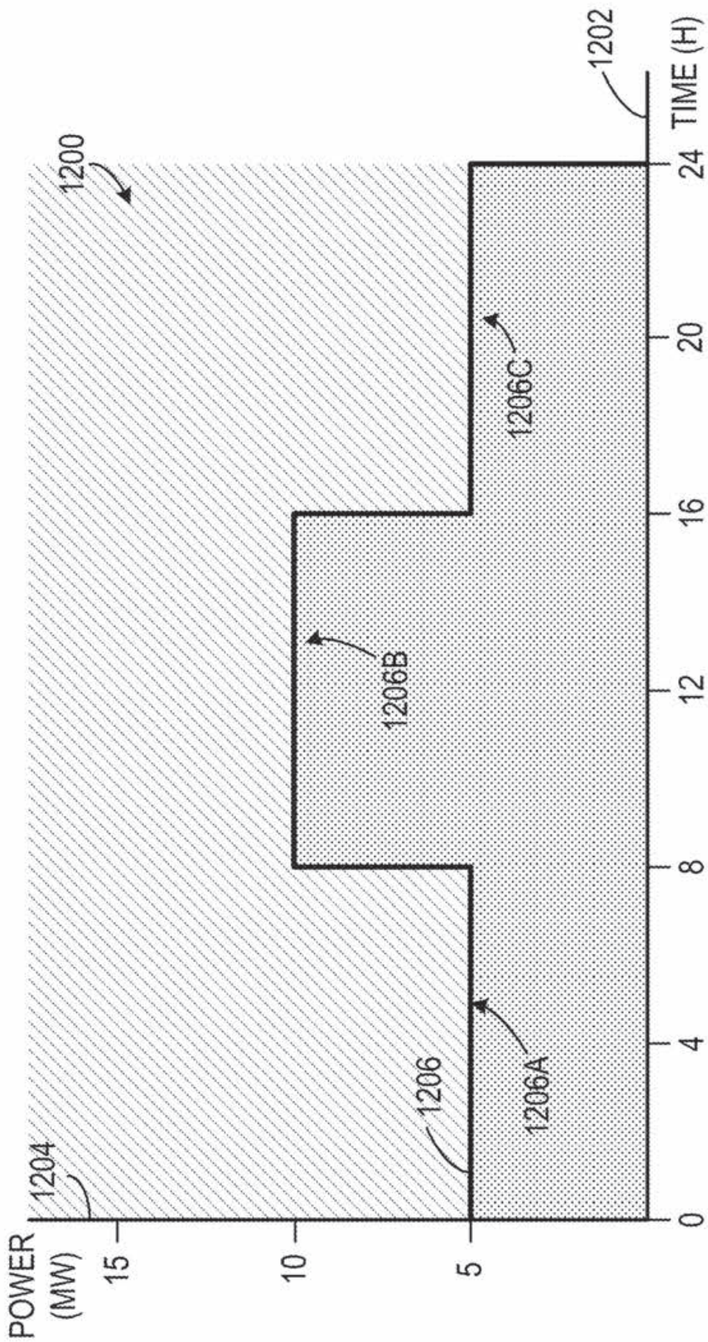

1200
POWER (MW)
15
10
5
0
4
8
12
16
20
24
TIME (H)
1202
1204
1206
1206A
1206B
1206C

FIGURE 12

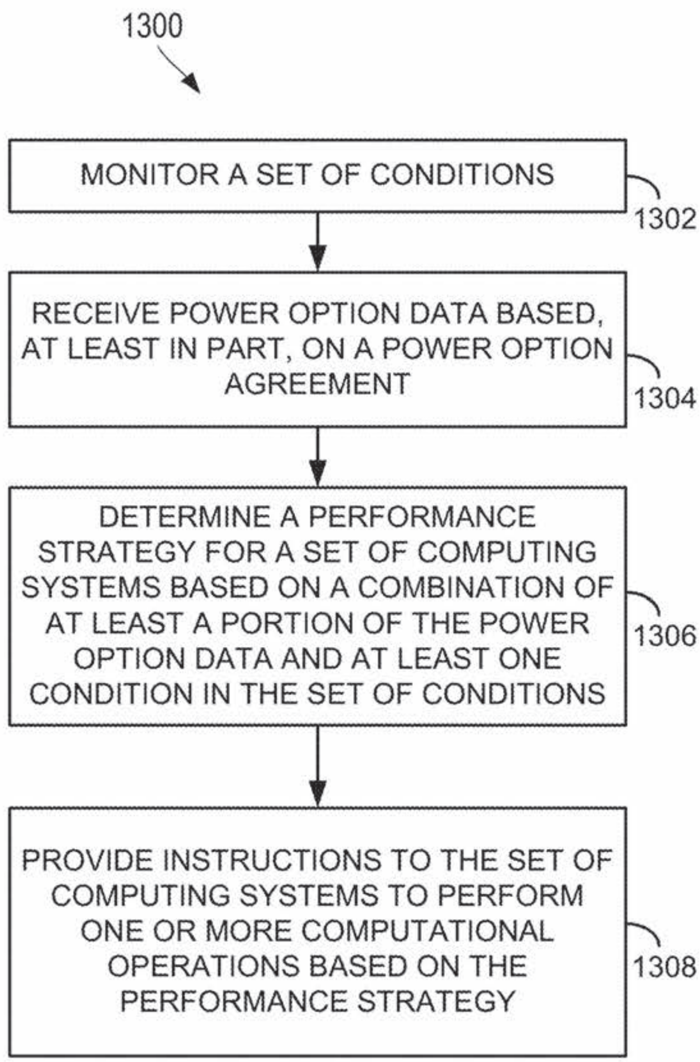

1300
MONITOR A SET OF CONDITIONS
1302
RECEIVE POWER OPTION DATA BASED, AT LEAST IN PART, ON A POWER OPTION AGREEMENT
1304
DETERMINE A PERFORMANCE STRATEGY FOR A SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE POWER OPTION DATA AND AT LEAST ONE CONDITION IN THE SET OF CONDITIONS
1306
PROVIDE INSTRUCTIONS TO THE SET OF COMPUTING SYSTEMS TO PERFORM ONE OR MORE COMPUTATIONAL OPERATIONS BASED ON THE PERFORMANCE STRATEGY
1308

FIGURE 13

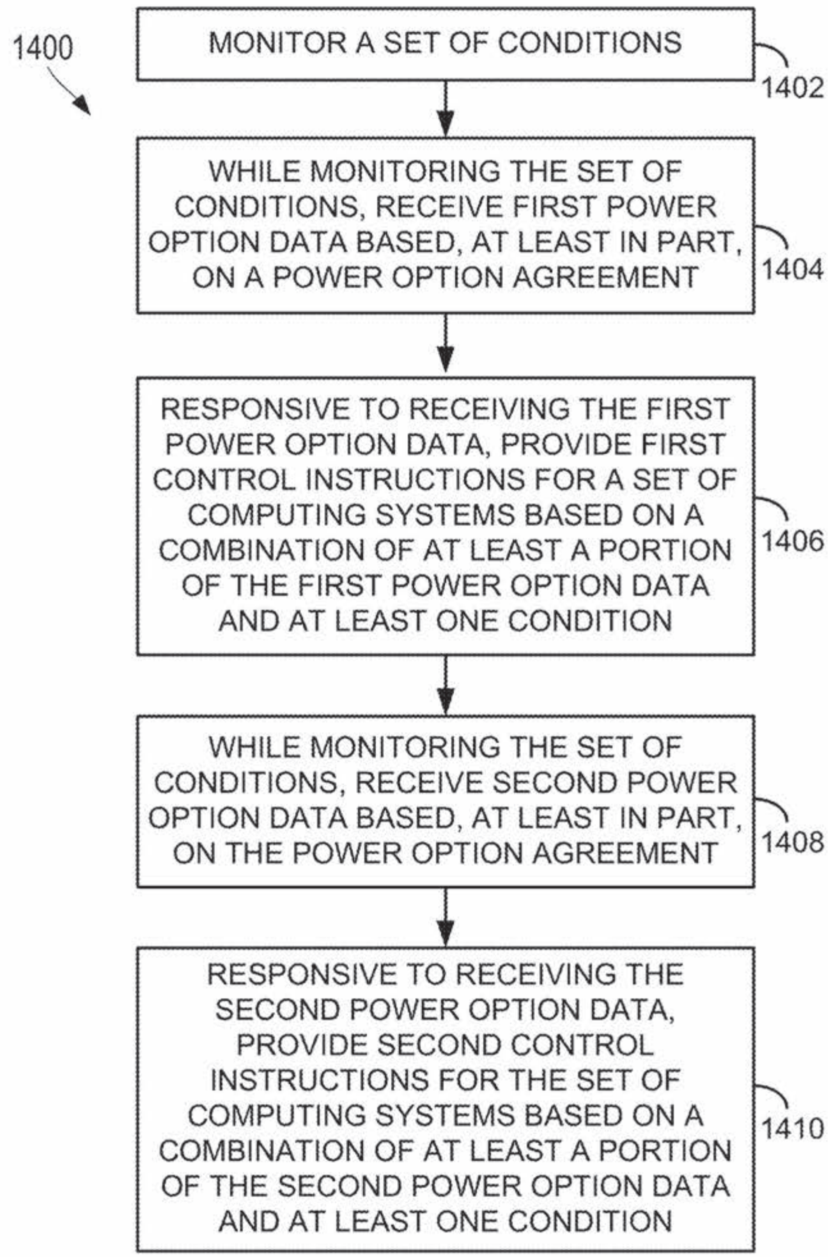

1400
MONITOR A SET OF CONDITIONS
1402
WHILE MONITORING THE SET OF CONDITIONS, RECEIVE FIRST POWER OPTION DATA BASED, AT LEAST IN PART, ON A POWER OPTION AGREEMENT
1404
RESPONSIVE TO RECEIVING THE FIRST POWER OPTION DATA, PROVIDE FIRST CONTROL INSTRUCTIONS FOR A SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE FIRST POWER OPTION DATA AND AT LEAST ONE CONDITION
1406
WHILE MONITORING THE SET OF CONDITIONS, RECEIVE SECOND POWER OPTION DATA BASED, AT LEAST IN PART, ON THE POWER OPTION AGREEMENT
1408
RESPONSIVE TO RECEIVING THE SECOND POWER OPTION DATA, PROVIDE SECOND CONTROL INSTRUCTIONS FOR THE SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE SECOND POWER OPTION DATA AND AT LEAST ONE CONDITION
1410

FIGURE 14

METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Patent Application No. 62/927,119, filed Oct. 28, 2019, the entire contents of which are herein incorporated by reference.

FIELD

This specification relates to power consumption adjustments when using grid power and/or intermittent behind-the-meter power.

BACKGROUND

"Electrical grid" or "grid," as used herein, refers to a Wide Area Synchronous Grid (also known as an Interconnection), and is a regional scale or greater electric power grid that that operates at a synchronized frequency and is electrically tied together during normal system conditions. An electrical grid delivers electricity from generation stations to consumers. An electrical grid includes: (i) generation stations that produce electrical power at large scales for delivery through the grid, (ii) high voltage transmission lines that carry that power from the generation stations to demand centers, and (iii) distribution networks carry that power to individual customers.

FIG. **1** illustrates a typical electrical grid, such as a North American Interconnection or the synchronous grid of Continental Europe (formerly known as the UCTE grid). The electrical grid of FIG. **1** can be described with respect to the various segments that make up the grid.

A generation segment **102** includes one or more generation stations that produce utility-scale electricity (typically >50 MW), such as a nuclear plant **102***a*, a coal plant **102***b*, a wind power station (i.e., wind farm) **102***c*, and/or a photovoltaic power station (i.e., a solar farm) **102***d*. Generation stations are differentiated from building-mounted and other decentralized or local wind or solar power applications because they supply power at the utility level and scale (>50 MW), rather than to a local user or users. The primary purpose of generation stations is to produce power for distribution through the grid, and in exchange for payment for the supplied electricity. Each of the generation stations **102***a-d* includes power generation equipment **102***e-h*, respectively, typically capable of supply utility-scale power (>50 MW). For example, the power generation equipment **102***g* at wind power station **102***c* includes wind turbines, and the power generation equipment **102***h* at photovoltaic power station **102***d* includes photovoltaic panels.

Each of the generation stations **102***a-d* may further include station electrical equipment **102***i***-1** respectively. Station electrical equipment **102***i***-1** are each illustrated in FIG. **1** as distinct elements for simplified illustrative purposes only and may, alternatively or additionally, be distributed throughout the power generation equipment, **102***e-h*, respectively. For example, at wind power station **102***c*, each wind turbine may include transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each wind turbine may be collected by distribution lines along strings of wind turbines and move through

collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the wind power station **102***c*. Similarly, at photovoltaic power station **102***d*, individual photovoltaic panels and/or arrays of photovoltaic panels may include inverters, transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each photovoltaic panel and/or array may be collected by distribution lines along the photovoltaic panels and move through collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the photovoltaic power station **102***d*.

Each generation station **102***a-d* may produce AC or DC electrical current which is then typically stepped up to a higher AC voltage before leaving the respective generation station. For example, wind turbines may typically produce AC electrical energy at 600V to 700V, which may then be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***c*. As another example, photovoltaic arrays may produce DC voltage at 600V to 900V, which is then inverted to AC voltage and may be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***d*.

Upon exiting the generation segment **102**, electrical power generated at generation stations **102***a-d* passes through a respective Point of Interconnection ("POI") **103** between a generation station (e.g., **102***a-d*) and the rest of the grid. A respective POI **103** represents the point of connection between a generation station's (e.g. **102***a-d*) equipment and a transmission system (e.g., transmission segment **104**) associated with electrical grid. In some cases, at the POI **103**, generated power from generation stations **102***a-d* may be stepped up at transformer systems **103***e-h* to high voltage scales suitable for long-distance transmission along transmission lines **104***a*. Typically, the generated electrical energy leaving the POI **103** will be at 115 kV AC or above, but in some cases it may be as low as, for example, 69 kV for shorter distance transmissions along transmission lines **104***a*. Each of transformer systems **103***e-h* may be a single transformer or may be multiple transformers operating in parallel or series and may be co-located or located in geographically distinct locations. Each of the transformer systems **103***e-h* may include substations and other links between the generation stations **102***a-d* and the transmission lines **104***a*.

A key aspect of the POI **103** is that this is where generation-side metering occurs. One or more utility-scale generation-side meters **103***a-d* (e.g., settlement meters) are located at settlement metering points at the respective POI **103** for each generation station **102***a-d*. The utility-scale generation-side meters **103***a-d* measure power supplied from generation stations **102***a-d* into the transmission segment **104** for eventual distribution throughout the grid.

For electricity consumption, the price consumers pay for power distributed through electric power grids is typically composed of, among other costs, Generation, Administration, and Transmission & Distribution ("T&D") costs. T&D costs represent a significant portion of the overall price paid by consumers for electricity. These costs include capital costs (land, equipment, substations, wire, etc.), costs associated with electrical transmission losses, and operation and maintenance costs.

For utility-scale electricity supply, operators of generation stations (e.g., **102***a-d*) are paid a variable market price for the amount of power the operator generates and provides to the grid, which is typically determined via a power purchase agreement (PPA) between the generation station operator and a grid operator. The amount of power the generation station operator generates and provides to the grid is measured by utility-scale generation-side meters (e.g., **103***a-d*) at settlement metering points. As illustrated in FIG. **1**, the utility-scale generation-side meters **103***a-d* are shown on a low side of the transformer systems **103***e-h*), but they may alternatively be located within the transformer systems **103***e-h* or on the high side of the transformer systems **103***e-h*. A key aspect of a utility-scale generation-side meter is that it is able to meter the power supplied from a specific generation station into the grid. As a result, the grid operator can use that information to calculate and process payments for power supplied from the generation station to the grid. That price paid for the power supplied from the generation station is then subject to T&D costs, as well as other costs, in order to determine the price paid by consumers.

After passing through the utility-scale generation-side meters in the POI **103**, the power originally generated at the generation stations **102***a-d* is transmitted onto and along the transmission lines **104***a* in the transmission segment **104**. Typically, the electrical energy is transmitted as AC at 115 kV+ or above, though it may be as low as 69 kV for short transmission distances. In some cases, the transmission segment **104** may include further power conversions to aid in efficiency or stability. For example, transmission segment **104** may include high-voltage DC ("HVDC") portions (along with conversion equipment) to aid in frequency synchronization across portions of the transmission segment **104**. As another example, transmission segment **104** may include transformers to step AC voltage up and then back down to aid in long distance transmission (e.g., 230 kV, 500 kV, 765 kV, etc.).

Power generated at the generation stations **104***a-d* is ultimately destined for use by consumers connected to the grid. Once the energy has been transmitted along the transmission segment **104**, the voltage will be stepped down by transformer systems **105***a-c* in the step down segment **105** so that it can move into the distribution segment **106**.

In the distribution segment **106**, distribution networks **106***a-c* take power that has been stepped down from the transmission lines **104***a* and distribute it to local customers, such as local sub-grids (illustrated at **106***a*), industrial customers, including large EV charging networks (illustrated at **106***b*), and/or residential and retail customers, including individual EV charging stations (illustrated at **106***c*). Customer meters **106***d*, **106***f* measure the power used by each of the grid-connected customers in distribution networks **106***a-c*. Customer meters **106***d* are typically load meters that are unidirectional and measure power use. Some of the local customers in the distribution networks **106***a-d* may have local wind or solar power systems **106***e* owned by the customer. As discussed above, these local customer power systems **106***e* are decentralized and supply power directly to the customer(s). Customers with decentralized wind or solar power systems **106***e* may have customer meters **106***f* that are bidirectional or net-metering meters that can track when the local customer power systems **106***e* produce power in excess of the customer's use, thereby allowing the utility to provide a credit to the customer's monthly electricity bill. Customer meters **106***d*, **106***f* differ from utility-scale generation-side meters (e.g., settlement meters) in at least the following characteristics: design (electro-mechanical or electronic vs current transformer), scale (typically less than 1600 amps vs. typically greater than 50 MW; typically less than 600V vs. typically greater than 14 kV), primary function (use vs. supply metering), economic purpose (credit against use vs payment for power), and location (in a distribution network at point of use vs. at a settlement metering point at a Point of Interconnection between a generation station and a transmission line).

To maintain stability of the grid, the grid operator strives to maintain a balance between the amount of power entering the grid from generation stations (e.g., **102***a-d*) and the amount of grid power used by loads (e.g., customers in the distribution segment **106**). In order to maintain grid stability and manage congestion, grid operators may take steps to reduce the supply of power arriving from generation stations (e.g., **102***a-d*) when necessary (e.g., curtailment). Particularly, grid operators may decrease the market price paid for generated power to dis-incentivize generation stations (e.g., **102***a-d*) from generating and supplying power to the grid. In some cases, the market price may even go negative such that generation station operators must pay for power they allow into the grid. In addition, some situations may arise where grid operators explicitly direct a generation station (e.g., **102***a-d*) to reduce or stop the amount of power the station is supplying to the grid.

Power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and operational directives resulting in reduced or discontinued generation all can have disparate effects on renewal energy generators and can occur multiple times in a day and last for indeterminate periods of time. Curtailment, in particular, is particularly problematic.

According to the National Renewable Energy Laboratory's Technical Report TP-6A20-60983 (March 2014):

> [C]urtailment [is] a reduction in the output of a generator from what it could otherwise produce given available resources (e.g., wind or sunlight), typically on an involuntary basis. Curtailments can result when operators or utilities command wind and solar generators to reduce output to minimize transmission congestion or otherwise manage the system or achieve the optimal mix of resources. Curtailment of wind and solar resources typically occurs because of transmission congestion or lack of transmission access, but it can also occur for reasons such as excess generation during low load periods that could cause baseload generators to reach minimum generation thresholds, because of voltage or interconnection issues, or to maintain frequency requirements, particularly for small, isolated grids. Curtailment is one among many tools to maintain system energy balance, which can also include grid capacity, hydropower and thermal generation, demand response, storage, and institutional changes. Deciding which method to use is primarily a matter of economics and operational practice.
>
> "Curtailment" today does not necessarily mean what it did in the early 2000s. Two separate changes in the electric sector have shaped curtailment practices since that time: the utility-scale deployment of wind power, which has no fuel cost, and the evolution of wholesale power markets. These simultaneous changes have led to new operational challenges but have also expanded the array of market-based tools for addressing them.
>
> Practices vary significantly by region and market design. In places with centrally-organized wholesale power markets and experience with wind power, manual wind energy curtailment processes are increasingly being

replaced by transparent offer-based market mechanisms that base dispatch on economics. Market protocols that dispatch generation based on economics can also result in renewable energy plants generating less than what they could potentially produce with available wind or sunlight. This is often referred to by grid operators by other terms, such as "downward dispatch." In places served primarily by vertically integrated utilities, power purchase agreements (PPAs) between the utility and the wind developer increasingly contain financial provisions for curtailment contingencies.

Some reductions in output are determined by how a wind operator values dispatch versus non-dispatch. Other curtailments of wind are determined by the grid operator in response to potential reliability events. Still other curtailments result from overdevelopment of wind power in transmission-constrained areas.

Dispatch below maximum output (curtailment) can be more of an issue for wind and solar generators than it is for fossil generation units because of differences in their cost structures. The economics of wind and solar generation depend on the ability to generate electricity whenever there is sufficient sunlight or wind to power their facilities.

Because wind and solar generators have substantial capital costs but no fuel costs (i.e., minimal variable costs), maximizing output improves their ability to recover capital costs. In contrast, fossil generators have higher variable costs, such as fuel costs. Avoiding these costs can, depending on the economics of a specific generator, to some degree reduce the financial impact of curtailment, especially if the generator's capital costs are included in a utility's rate base.

Curtailment may result in available energy being wasted because solar and wind operators have zero variable cost (which may not be true to the same extent for fossil generation units which can simply reduce the amount of fuel that is being used). With wind generation, in particular, it may also take some time for a wind farm to become fully operational following curtailment. As such, until the time that the wind farm is fully operational, the wind farm may not be operating with optimum efficiency and/or may not be able to provide power to the grid.

SUMMARY

In an example, a system includes a set of computing systems. The set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and, while monitoring the set of conditions, receive first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The control system is further configured to provide first control instructions for the set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions responsive to receiving the first power option data. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The control system is also configured to, while monitoring the set of conditions, receive second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. Responsive to receiving the second power option data, the control system is configured to provide second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and wherein the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In another example, a method involves monitoring, at a computing system, a set of conditions, and while monitoring the set of conditions, receiving first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The method further involves, responsive to receiving the first power option data, providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The method further involves, while monitoring the set of conditions, receiving second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. The method also involves, responsive to receiving the second power option data, providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In yet another example, a system is provided. The system includes a set of computing systems, where the set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and receive power option data based, at least in part, on a power option agreement. The power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, where each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals. The control system is further configured to, responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, where each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The control system is also configured to provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

In a further example, non-transitory computer-readable medium is described that is configured to store instructions,

that when executed by a computing system, causes the computing system to perform operations consistent with the method steps described above.

Other aspects of the present invention will be apparent from the following description and claims.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** shows a typical electrical grid.

FIG. **2** shows a behind-the-meter arrangement with optional grid power, including one or more flexible datacenters, according to one or more example embodiments.

FIG. **3** shows a block diagram of a remote master control system, according to one or more example embodiments.

FIG. **4** a block diagram of a generation station, according to one or more example embodiments.

FIG. **5** shows a block diagram of a flexible datacenter, according to one or more example embodiments.

FIG. **6**A shows a structural arrangement of a flexible datacenter, according to one or more example embodiments.

FIG. **6**B shows a set of computing systems arranged in a straight configuration, according to one or more example embodiments.

FIG. **7** shows a control distribution system for a flexible datacenter, according to one or more example embodiments.

FIG. **8** shows a control distribution system for a fleet of flexible datacenters, according to one or more example embodiments.

FIG. **9** shows a queue distribution system for a traditional datacenter and a flexible datacenter, according to one or more example embodiments.

FIG. **10**A shows a method of dynamic power consumption at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **10**B shows a method of dynamic power delivery at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **11** shows a block diagram of a system for implementing power consumption adjustments based on a power option agreement, according to one or more embodiments.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments.

FIG. **13** shows a method for implementing power consumption adjustments based on a fixed-duration power option agreement, according to one or more embodiments.

FIG. **14** shows a method for implementing power consumption adjustments based on a dynamic power option agreement, according to one or more embodiments.

DETAILED DESCRIPTION

Disclosed examples will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all of the disclosed examples are shown. Different examples may be described and should not be construed as limited to the examples set forth herein.

As discussed above, the market price paid to generation stations for supplying power to the grid often fluctuates due to various factors, including the need to maintain grid stability and based on current demand and usage by connected loads in distribution networks. Due to these factors, situations can arise where generation stations are offered substantially lower prices to deter an over-supply of power to the grid. Although these situations typically exist temporarily, generation stations are sometimes forced to either sell power to the grid at the much lower prices or adjust operations to decrease the amount of power generated. Furthermore, some situations may even require generation stations to incur costs in order to offload power to the grid or to shut down generation temporarily.

The volatility in the market price offered for power supplied to the grid can be especially problematic for some types of generation stations. In particular, wind farms and some other types of renewable resource power producers may lack the ability to quickly adjust operations in response to changes in the market price offered for supplying power to the grid. As a result, power generation and management at some generation stations can be inefficient, which can frequently result in power being sold to the grid at low or negative prices. In some situations, a generation station may even opt to halt power generation temporarily to avoid such unfavorable pricing. As such, the time required to halt and to restart the power generation at a generation station can reduce the generation station's ability to take advantage of rising market prices for power supplied to the grid.

Example embodiments provided herein aim to assist generation stations in managing power generation operations and avoid unfavorable power pricing situations like those described above. In particular, example embodiments may involve providing a load that is positioned behind-the-meter ("BTM") and enabling the load to utilize power received behind-the-meter at a generation station in a timely manner. As a general rule of thumb, BTM power is not subject to traditional T&D costs.

For purposes herein, a generation station is considered to be configured for the primary purpose of generating utility-scale power for supply to the electrical grid (e.g., a Wide Area Synchronous Grid or a North American Interconnect).

In one embodiment, equipment located behind-the-meter ("BTM equipment") is equipment that is electrically connected to a generation station's power generation equipment behind (i.e., prior to) the generation station's POI with an electrical grid.

In one embodiment, behind-the-meter power ("BTM power") is electrical power produced by a generation station's power generation equipment and utilized behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM equipment receives power from the generation station, but the power received by the BTM equipment from the generation station has not passed through the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM power is utilized before being metered at the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that supplies power to a grid, and the BTM equipment receives power from the generation station that is not subject to T&D charges, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that supplies power to a grid, and the BTM power is not subject to T&D charges before being used by electrical equipment, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, equipment may be considered behind-the-meter if the BTM equipment receives power generated from the generation station and that received power is not routed through the electrical grid before being delivered to the BTM equipment.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station, and BTM equipment receives that generated power, and that generated power received by the BTM equipment is not routed through the electrical grid before being delivered to the BTM equipment.

For purposes herein, BTM equipment may also be referred to as a behind-the-meter load ("BTM load") when the BTM equipment is actively consuming BTM power.

Beneficially, where BTM power is not subject to traditional T&D costs, a wind farm or other type of generation station can be connected to BTM loads which can allow the generation station to selectively avoid the adverse or less-than optimal cost structure occasionally associated with supplying power to the grid by shunting generated power to the BTM load.

An arrangement that positions and connects a BTM load to a generation station can offer several advantages. In such arrangements, the generation station may selectively choose whether to supply power to the grid or to the BTM load, or both. The operator of a BTM load may pay to utilize BTM power at a cost less than that charged through a consumer meter (e.g., **106***d*, **1060** located at a distribution network (e.g., **106***a-c*) receiving power from the grid. The operator of a BTM load may additionally or alternatively charge less than the market rate to consume excess power generated at the generation station during curtailment. As a result, the generation station may direct generated power based on the "best" price that the generation station can receive during a given time frame, and/or the lowest cost the generation station may incur from negative market pricing during curtailment. The "best" price may be the highest price that the generation station may receive for its generated power during a given duration, but can also differ within embodiments and may depend on various factors, such as a prior PPA.

In one example, by having a behind-the-meter option available, a generation station may transition from supplying all generated power to the grid to supplying some or all generated power to one or more BTM loads when the market price paid for power by grid operators drops below a predefined threshold (e.g., the price that the operator of the BTM load is willing to pay the generation station for power). Thus, by having an alternative option for power consumption (i.e., one or more BTM loads), the generation station can selectively utilize the different options to maximize the price received for generated power. In addition, the generation station may also utilize a BTM load to avoid or reduce the economic impact in situations when supplying power to the grid would result in the generation station incurring a net cost.

Providing BTM power to a load can also benefit the BTM load operator. A BTM load may be able to receive and utilize BTM power received from the generation station at a cost that is lower than the cost for power from the grid (e.g., at a customer meter **106***d*, **1060**. This is primarily due to the avoidance (or significant reduction) in T&D costs and the market effects of curtailment. As indicated above, the generation station may be willing to divert generated power to the BTM load rather than supplying the grid due to changing market conditions, or during maintenance periods, or for other non-market conditions. Thus, some situations may arise where the generation station offers power to the BTM load at a price that is substantially lower than the price available on the grid. Furthermore, in some situations, the BTM load may even be able to obtain and utilize BTM power from a generation station at no cost or even at negative pricing since the generation station may rather supply the BTM load with generated power during a given time range instead of paying a higher price for the grid to take the power or modifying operations to decrease power output.

Another example of cost-effective use of BTM power is when the generation station **202** is selling power to the grid at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price the generation station **202** would have to pay to the grid power to offload generation's station **202** generated power. Advantageously, one or more flexible datacenters **220** may take the generated power behind-the-meter, thereby allowing the generation station **202** to produce and obtain the production tax credit, while selling less power to the grid at the negative price.

Another example of cost-effective behind-the-meter power is when the generation station **202** is selling power to the grid at a negative price because the grid is oversupplied and/or the generation station **202** is instructed to stand down and stop producing altogether. A grid operator may select and direct certain generation stations to go offline and stop supplying power to the grid. Advantageously, one or more flexible datacenters may be used to take power behind-the-meter, thereby allowing the generation station **202** to stop supplying power to the grid, but still stay online and make productive use of the power generated.

Another example of beneficial behind-the-meter power use is when the generation station **202** is producing power that is, with reference to the grid, unstable, out of phase, or at the wrong frequency, or the grid is already unstable, out of phase, or at the wrong frequency. A grid operator may select certain generation stations to go either offline and stop producing power, or to take corrective action with respect to the grid power stability, phase, or frequency. Advantageously, one or more flexible datacenters **220** may be used to selectively consume power behind-the-meter, thereby allowing the generation station **202** to stop providing power to the grid and/or provide corrective feedback to the grid.

Another example of beneficial behind-the-meter power use is that cost-effective behind-the-meter power availability may occur when the generation station **202** is starting up or testing. Individual equipment in the power generation equipment **210** may be routinely offline for installation, maintenance, and/or service and the individual units must be tested prior to coming online as part of overall power generation equipment **210**. During such testing or maintenance time, one or more flexible datacenters may be intermittently

powered by the one or more units of the power generation equipment **210** that are offline from the overall power generation equipment **210**.

Another example of beneficial behind-the-meter power use is that datacenter control systems at the flexible datacenters **220** may quickly ramp up and ramp down power consumption by computing systems in the flexible datacenters **220** based on power availability from the generation station **202**. For instance, if the grid requires additional power and signals the demand via a higher local price for power, the generation station **202** can supply the grid with power nearly instantly by having active flexible datacenters **220** quickly ramp down and turn off computing systems (or switch to a stored energy source), thereby reducing an active BTM load.

Another example of beneficial behind-the-meter power use is in new photovoltaic generation stations **202**. For example, it is common to design and build new photovoltaic generation stations with a surplus of power capacity to account for degradation in efficiency of the photovoltaic panels over the life of the generation stations. Excess power availability at the generation station can occur when there is excess local power generation and/or low grid demand. In high incident sunlight situations, a photovoltaic generation station **202** may generate more power than the intended capacity of generation station **202**. In such situations, a photovoltaic generation station **202** may have to take steps to protect its equipment from damage, which may include taking one or more photovoltaic panels offline or shunting their voltage to dummy loads or the ground. Advantageously, one or more flexible datacenters (e.g., the flexible datacenters **220**) may take power behind-the-meter at the Generations Station **202**, thereby allowing the generation station **202** to operate the power generation equipment **210** within operating ranges while the flexible datacenters **220** receive BTM power without transmission or distribution costs.

Thus, for at least the reasons described herein, arrangements that involves providing a BTM load as an alternative option for a generation station to direct its generated power to can serve as a mutually beneficial relationship in which both the generation station and the BTM load can economically benefit. The above-noted examples of beneficial use of BTM power are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as benefits to unutilized BTM power capacity, BTM power pricing, or BTM power consumption.

Within example embodiments described herein, various types of utility-scale power producers may operate as generation stations **202** that are capable of supplying power to one or more loads behind-the-meter. For instance, renewable energy sources (e.g., wind, solar, hydroelectric, wave, water current, tidal), fossil fuel power generation sources (coal, natural gas), and other types of power producers (e.g., nuclear power) may be positioned in an arrangement that enables the intermittent supply of generated power behind-the-meter to one or more BTM loads. One of ordinary skill in the art will recognize that the generation station **202** may vary based on an application or design in accordance with one or more example embodiments.

In addition, the particular arrangement (e.g., connections) between the generation station and one or more BTM loads can vary within examples. In one embodiment, a generation station may be positioned in an arrangement wherein the generation station selectively supplies power to the grid and/or to one or more BTM loads. As such, power cost-analysis and other factors (e.g., predicted weather conditions, contractual obligations, etc.) may be used by the generation station, a BTM load control system, a remote master control system, or some other system or enterprise, to selectively output power to either the grid or to one or more BTM loads in a manner that maximizes revenue to the generation station. In such an arrangement, the generation station may also be able to supply both the grid and one or more BTM loads simultaneously. In some instances, the arrangement may be configured to allow dynamic manipulation of the percentage of the overall generated power that is supplied to each option at a given time. For example, in some time periods, the generation station may supply no power to the BTM load.

In addition, the type of loads that are positioned behind-the-meter can vary within example embodiments. In general, a load that is behind-the-meter may correspond to any type of load capable of receiving and utilizing power behind-the-meter from a generation station. Some examples of loads include, but are not limited to, datacenters and electric vehicle (EV) charging stations.

Preferred BTM loads are loads that can be subject to intermittent power supply because BTM power may be available intermittently. In some instances, the generation station may generate power intermittently. For example, wind power station **102***c* and/or photovoltaic power station **102***d* may only generate power when resource are available or favorable. Additionally or alternatively, BTM power availability at a generation station may only be available intermittently due to power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and/or operational directives from grid operators or generation station operators.

Some example embodiments of BTM loads described herein involve using one or more computing systems to serve as a BTM load at a generation station. In particular, the computing system or computing systems may receive power behind-the-meter from the generation station to perform various computational operations, such as processing or storing information, performing calculations, mining for cryptocurrencies, supporting blockchain ledgers, and/or executing applications, etc.

Multiple computing systems positioned behind-the-meter may operate as part of a "flexible" datacenter that is configured to operate only intermittently and to receive and utilize BTM power to carry out various computational operations similar to a traditional datacenter. In particular, the flexible datacenter may include computing systems and other components (e.g., support infrastructure, a control system) configured to utilize BTM power from one or more generation stations. The flexible datacenter may be configured to use particular load ramping abilities (e.g., quickly increase or decrease power usage) to effectively operate during intermittent periods of time when power is available from a generation station and supplied to the flexible datacenter behind-the-meter, such as during situations when supplying generated power to the grid is not favorable for the generation station.

In some instances, the amount of power consumed by the computing systems at a flexible datacenter can be ramped up and down quickly, and potentially with high granularity (i.e., the load can be changed in small increments if desired). This may be done based on monitored power system conditions or other information analyses as discussed herein. As recited above, this can enable a generation station to avoid negative power market pricing and to respond quickly to grid direc-

tives. And by extension, the flexible datacenter may obtain BTM power at a price lower than the cost for power from the grid.

Various types of computing systems can provide granular power ramping. Preferably, the computing systems can perform computational tasks that are immune to, or not substantially hindered by, frequent interruptions or slowdowns in processing as the computing systems ramp down or up. In some embodiments, a control system may be used to activate or de-activate one or more computing systems in an array of computing systems. For example, the control system may provide control instructions to one or more blockchain miners (e.g., a group of blockchain miners), including instructions for powering on or off, adjusting frequency of computing systems performing operations (e.g., adjusting the processing frequency), adjusting the quantity of operations being performed, and when to operate within a low power mode (if available).

Within examples, a control system may correspond to a specialized computing system or may be a computing system within a datacenter serving in the role of the control system. The location of the control system can vary within examples as well. For instance, the control system may be located at a datacenter or physically separate from the datacenter. In some examples, the control system may be part of a network of control systems that manage computational operations, power consumption, and other aspects of a fleet of datacenters. The fleet of datacenters may include one or more traditional datacenters and/or flexible datacenters.

Some embodiments may involve using one or more control systems to direct time-insensitive (e.g., interruptible) computational tasks to computational hardware, such as central processing units (CPUs) and graphics processing units (GPUs), sited behind the meter, while other hardware is sited in front of the meter (i.e., consuming metered grid power via a customer meter (e.g., **106***d*, **1060**) and possibly remote from the behind-the-meter hardware. As such, parallel computing processes, such as Monte Carlo simulations, batch processing of financial transactions, graphics rendering, machine learning, neural network processing, queued operations, and oil and gas field simulation models, are good candidates for such interruptible computational operations.

FIG. **2** shows a behind-the-meter arrangement with optional grid-power, including one or more flexible datacenters, according to one or more example embodiments. Dark arrows illustrate a typical power delivery direction. Consistent with FIG. **1**, the arrangement illustrates a generation station **202** in the generation segment **102** of a Wide-Area Synchronous Grid. The generation station **202** supplies utility-scale power (typically >50 MW) via a generation power connection **250** to the Point of Interconnection **103** between the generation station **202** and the rest of the grid. Typically, the power supplied on connection **250** may be at 34.5 kV AC, but it may be higher or lower. Depending on the voltage at connection **250** and the voltage at transmission lines **104***a*, a transformer system **203** may step up the power supplied from the generation station **202** to high voltage (e.g., 115 kV+AC) for transmission over connection **252** and onto transmission lines **104***a* of transmission segment **104**. Grid power carried on the transmission segment **104** may be from generation station **202** as well as other generation stations (not shown). Also consistent with FIG. **1**, grid power is consumed at one or more distribution networks, including example distribution network **206**. Grid power may be taken from the transmission lines **104***a* via connector **254** and stepped down to distribution network voltages (e.g., typically 4 kV to 26 kV AC) and sent into the distribution networks, such as distribution network **206** via distribution line **256**. The power on distribution line **256** may be further stepped down (not shown) before entering individual consumer facilities such as a remote master control system **262** and/or traditional datacenters **260** via customer meters **206**A, which may correspond to customer meters **106***d* in FIG. **1**, or customer meters **106***f* in FIG. **1** if the respective consumer facility includes a local customer power system, such as **106***e* (not shown in FIG. **2**).

Consistent with FIG. **1**, power entering the grid from generation station **202** is metered by a utility-scale generation-side meter. A utility-scale generation-side meter **253** is shown on the low side of transformer system **203** and an alternative location is shown as **253**A on the high side of transformer system **203**. Both locations may be considered settlement metering points for the generation station **202** at the POI **103**. Alternatively, a utility-scale generation-side meter for the generation station **202** may be located at another location consistent with the descriptions of such meters provided herein.

Generation station **202** includes power generation equipment **210**, which may include, as examples, wind turbines and/or photovoltaic panels. Power generation equipment **210** may further include other electrical equipment, including but not limited to switches, busses, collectors, inverters, and power unit transformers (e.g., transformers in wind turbines).

As illustrated in FIG. **2**, generation station **202** is configured to connect with BTM equipment which may function as BTM loads. In the illustrated embodiment of FIG. **2**, the BTM equipment includes flexible datacenters **220**. Various configurations to supply BTM power to flexible datacenters **220** within the arrangement of FIG. **2** are described herein.

In one configuration, generated power may travel from the power generation equipment **210** over one or more connectors **230**A, **230**B to one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **230**A, **230**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **230**B is shown with an open switch, and connector **230**A is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used in various embodiments when BTM power is supplied without significant power conversion to BTM loads.

In various configurations, the busses **240**A and **240**B may be separated by an open switch **240**C or combined into a common bus by a closed switch **240**C.

In another configuration, generated power may travel from the power generation equipment **210** to the high side of a local step-down transformer **214**. The generated power may then travel from the low side of the local step-down transformer **214** over one or more connectors **232**A, **232**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **232**A, **232**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **232**A is shown with an open switch, and connector **232**B is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the power generation equipment **210**, but the generated power must be stepped down prior to use at the BTM loads.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of a local step-up transformer **212**. The generated power may

then travel from the high side of the local step-up transformer **212** over one or more connectors **234**A, **234**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **234**A, **234**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **234**A, **234**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of the local step-up transformer **212**. The generated power may then travel from the high side of the local step-up transformer **212** to the high side of local step-down transformer **213**. The generated power may then travel from the low side of the local step-down transformer **213** over one or more connectors **236**A, **236**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **236**A, **2346** may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **236**A, **236**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**, but the power must be stepped down prior to use at the BTM loads.

In one embodiment, power generated at the generation station **202** may be used to power a generation station control system **216** located at the generation station **202**, when power is available. The generation station control system **216** may typically control the operation of the generation station **202**. Generated power used at the generation station control system **216** may be supplied from bus **240**A via connector **216**A and/or from bus **240**B via connector **216**B. Each of the connectors **216**A, **216**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. While the generation station control system **216** can consume BTM power when powered via bus **240**A or bus **240**B, the BTM power taken by generation station control system **216** is insignificant in terms of rendering an economic benefit. Further, the generation station control system **216** is not configured to operate intermittently, as it generally must remain always on. Further still, the generation station control system **216** does not have the ability to quickly ramp a BTM load up or down.

In another embodiment, grid power may alternatively or additionally be used to power the generation station control system **216**. As illustrated here, metered grid power from a distribution network, such as distribution network **206** for simplicity of illustration purposes only, may be used to power generation station control system **216** over connector **216**C. Connector **216**C may be a switched connector so that metered grid power to the generation station control system **216** can be switched on or off as needed. More commonly, metered grid power would be delivered to the generation station control system **216** via a separate distribution network (not shown), and also over a switched connector. Any such grid power delivered to the generation station control system **216** is metered by a customer meter **206**A and subject to T&D costs.

In another embodiment, when power generation equipment **210** is in an idle or off state and not generating power, grid power may backfeed into generation station **202** through POI **103** and such grid power may power the generation station control system **216**.

In some configurations, an energy storage system **218** may be connected to the generation station **202** via connector **218**A, which may be a switched connector. For illustrative purposes only, connector **218**A is shown with an open switch but in some embodiments it may be closed. The energy storage system **218** may be connected to bus **240**A and/or bus **240**B and store energy produced by the power generation equipment **210**. The energy storage system may also be isolated from generation station **202** by switch **242**A. In times of need, such as when the power generation equipment in an idle or off state and not generating power, the energy storage system may feed power to, for example, the flexible datacenters **220**. The energy storage system may also be isolated from the flexible datacenters **220** by switch **242**B.

In a preferred embodiment, as illustrated, power generation equipment **210** supplies BTM power via connector **242** to flexible datacenters **220**. The BTM power used by the flexible datacenters **220** was generated by the generation station **202** and did not pass through the POI **103** or utility-scale generation-side meter **253**, and is not subject to T&D charges. Power received at the flexible datacenters **220** may be received through respective power input connectors **220**A. Each of the respective connectors **220**A may be switched connector that can electrically isolate the respective flexible datacenter **220** from the connector **242**. Power equipment **220**B may be arranged between the flexible datacenters **220** and the connector **242**. The power equipment **220**B may include, but is not limited to, power conditioners, unit transformers, inverters, and isolation equipment. As illustrated, each flexible datacenter **220** may be served by a respective power equipment **220**B. However, in another embodiment, one power equipment **220**B may serve multiple flexible datacenter **220**.

In one embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter and electrically connected to the power generation equipment **210** behind (i.e., prior to) the generation station's POI **103** with the rest of the electrical grid.

In one embodiment, BTM power produced by the power generation equipment **210** is utilized by the flexible datacenters **220** behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter as the flexible datacenters **220** are electrically connected to the generation station **202**, and generation station **202** is subject to metering by utility-scale generation-side meter **253** (or **253**A, or another utility-scale generation-side meter), and the flexible datacenters **220** receive power from the generation station **202**, but the power received by the flexible datacenters **220** from the generation station **202** has not passed through a utility-scale generation-side meter. In this embodiment, the utility-scale generation-side meter **253** (or **253**A) for the generation station **202** is located at the generation station's **202** POI **103**. In another embodiment, the utility-scale generation-side meter for the generation station **202** is at a location other than the POI for the generation station **202**—for example, a substation (not shown) between the generation station **202** and the generation station's POI **103**.

In another embodiment, power from the generation station **202** is supplied to the flexible datacenters **220** as BTM power, where power produced at the generation station **202** is subject to metering by utility-scale generation-side meter

253 (or 253A, or another utility-scale generation-side meter), but the BTM power supplied to the flexible datacenters 220 is utilized before being metered at the utility-scale generation-side meter 253 (or 253A, or another utility-scale generation-side meter). In this embodiment, the utility-scale generation-side meter 253 (or 253A) for the generation station 202 is located at the generation station's 202 POI 103. In another embodiment, the utility-scale generation-side meter for the generation station 202 is at a location other than the POI for the generation station 202—for example, a substation (not shown) between the generation station 202 and the generation station's POI 103.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter as they are electrically connected to the generation station 202 that supplies power to the grid, and the flexible datacenters 220 receive power from the generation station 202 that is not subject to T&D charges, but power otherwise received from the grid that is supplied by the generation station 202 is subject to T&D charges.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 that supplies power to a grid, and the generated power is not subject to T&D charges before being used by flexible datacenters 220, but power otherwise received from the connected grid is subject to T&D charges.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter because they receive power generated from the generation station 202 intended for the grid, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 for distribution to the grid, and the flexible datacenters 220 receive that power, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, metered grid power may alternatively or additionally be used to power one or more of the flexible datacenters 220, or a portion within one or more of the flexible datacenters 220. As illustrated here for simplicity, metered grid power from a distribution network, such as distribution network 206, may be used to power one or more flexible datacenters 220 over connector 256A and/or 256B. Each of connector 256A and/or 256B may be a switched connector so that metered grid power to the flexible datacenters 220 can be switched on or off as needed. More commonly, metered grid power would be delivered to the flexible datacenters 220 via a separate distribution network (not shown), and also over switched connectors. Any such grid power delivered to the flexible datacenters 220 is metered by customer meters 206A and subject to T&D costs. In one embodiment, connector 256B may supply metered grid power to a portion of one or more flexible datacenters 220. For example, connector 256B may supply metered grid power to control and/or communication systems for the flexible datacenters 220 that need constant power and cannot be subject to intermittent BTM power. Connector 242 may supply solely BTM power from the generation station 202 to high power demand computing systems within the flexible datacenters 220, in which case at least a portion of each flexible datacenters 220 so connected is operating as a BTM load. In another embodiment, connector 256A and/or 256B may supply all power used at one or more of the flexible datacenters 220, in which case each of the flexible datacenters 220 so connected would not be operating as a BTM load.

In another embodiment, when power generation equipment 210 is in an idle or off state and not generating power, grid power may backfeed into generation station 202 through POI 103 and such grid power may power the flexible datacenters 220.

The flexible datacenters 220 are shown in an example arrangement relative to the generation station 202. Particularly, generated power from the generation station 202 may be supplied to the flexible datacenters 220 through a series of connectors and/or busses (e.g., 232B, 240B, 242, 220A). As illustrated, in other embodiments, connectors between the power generation equipment 210 and other components may be switched open or closed, allowing other pathways for power transfer between the power generation equipment 210 and components, including the flexible datacenters 220. Additionally, the connector arrangement shown is illustrative only and other circuit arrangements are contemplated within the scope of supplying BTM power to a BTM load at generation station 202. For example, there may be more or fewer transformers, or one or more of transformers 212, 213, 214 may be transformer systems with multiple steppings and/or may include additional power equipment including but not limited to power conditioners, filters, switches, inverters, and/or AC/DC-DC/AC isolators. As another example, metered grid power connections to flexible datacenters 220 are shown via both 256A and 256B; however, a single connection may connect one or more flexible datacenters 220 (or power equipment 220B) to metered grid power and the one or more flexible datacenters 220 (or power equipment 220B) may include switching apparatus to direct BTM power and/or metered grid power to control systems, communication systems, and/or computing systems as desired.

In some examples, BTM power may arrive at the flexible datacenters 220 in a three-phase AC format. As such, power equipment (e.g., power equipment 220B) at one or more of the flexible datacenters 220 may enable each flexible datacenter 220 to use one or more phases of the power. For instance, the flexible datacenters 220 may utilize power equipment (e.g., power equipment 220B, or alternatively or additionally power equipment that is part of the flexible datacenter 220) to convert BTM power received from the generation station 202 for use at computing systems at each flexible datacenter 220. In other examples, the BTM power may arrive at one or more of the flexible datacenters 220 as DC power. As such, the flexible datacenters 220 may use the DC power to power computing systems. In some such examples, the DC power may be routed through a DC-to-DC converter that is part of power equipment 220B and/or flexibles datacenter 220.

In some configurations, a flexible datacenter 220 may be arranged to only have access to power received behind-the-meter from a generation station 202. In the arrangement of FIG. 2, the flexible datacenters 220 may be arranged only with a connection to the generation station 202 and depend solely on power received behind-the-meter from the generation station 202. Alternatively or additionally, the flexible datacenters 220 may receive power from energy storage system 218.

In some configurations, one or more of the flexible datacenters 220 can be arranged to have connections to multiple sources that are capable of supplying power to a flexible datacenter 220. To illustrate a first example, the flexible datacenters 220 are shown connected to connector 242, which can be connected or disconnected via switches to

the energy storage system **218** via connector **218**A, the generation station **202** via bus **240**B, and grid power via metered connector **256**A. In one embodiment, the flexible datacenters **220** may selectively use power received behind-the-meter from the generation station **202**, stored power supplied by the energy storage system **218**, and/or grid power. For instance, flexible datacenters **220** may use power stored in the energy storage system **218** when costs for using power supplied behind-the-meter from the generation station **202** are disadvantageous. By having access to the energy storage system **218** available, the flexible datacenters **220** may use the stored power and allow the generation station **202** to subsequently refill the energy storage system **218** when cost for power behind-the-meter is low. Alternatively, the flexible datacenters **220** may use power from multiple sources simultaneously to power different components (e.g., a first set and a second set of computing systems). Thus, the flexible datacenters **220** may leverage the multiple connections in a manner that can reduce the cost for power used by the computing systems at the flexible datacenters **220**. The flexible datacenters **220** control system or the remote master control system **262** may monitor power conditions and other factors to determine whether the flexible datacenters **220** should use power from either the generation station **202**, grid power, the energy storage system **218**, none of the sources, or a subset of sources during a given time range. Other arrangements are possible as well. For example, the arrangement of FIG. **2** illustrates each flexible datacenter **220** as connected via a single connector **242** to energy storage system **218**, generation station **202**, and metered grid power via **256**A. However, one or more flexible datacenters **220** may have independent switched connections to each energy source, allowing the one or more flexible datacenters **220** to operate from different energy sources than other flexible datacenters **220** at the same time.

The selection of which power source to use at a flexible datacenter (e.g., the flexible datacenters **220**) or another type of BTM load can change based on various factors, such as the cost and availability of power from both sources, the type of computing systems using the power at the flexible datacenters **220** (e.g., some systems may require a reliable source of power for a long period), the nature of the computational operations being performed at the flexible datacenters **220** (e.g., a high priority task may require immediate completion regardless of cost), and temperature and weather conditions, among other possible factors. As such, a datacenter control system at the flexible datacenters **220**, the remote master control system **262**, or another entity (e.g., an operator at the generation station **202**) may also influence and/or determine the source of power that the flexible datacenters **220** use at a given time to complete computational operations.

In some example embodiments, the flexible datacenters **220** may use power from the different sources to serve different purposes. For example, the flexible datacenters **220** may use metered power from grid power to power one or more systems at the flexible datacenters **220** that are configured to be always-on (or almost always on), such as a control and/or communication system and/or one or more computing systems (e.g., a set of computing systems performing highly important computational operations). The flexible datacenters **220** may use BTM power to power other components within the flexible datacenters **220**, such as one or more computing systems that perform less critical computational operations.

In some examples, one or more flexible datacenters **220** may be deployed at the generation station **202**. In other

examples, flexible datacenters **220** may be deployed at a location geographically remote from the generation station **202**, while still maintaining a BTM power connection to the generation station **202**.

In another example arrangement, the generation station **202** may be connected to a first BTM load (e.g., a flexible datacenter **220**) and may supply power to additional BTM loads via connections between the first BTM load and the additional BTM loads (e.g., a connection between a flexible datacenter **220** and another flexible datacenter **220**).

The arrangement in FIG. **2**, and components included therein, are for non-limiting illustration purposes and other arrangements are contemplated in examples. For instance, in another example embodiment, the arrangement of FIG. **2** may include more or fewer components, such as more BTM loads, different connections between power sources and loads, and/or a different number of datacenters. In addition, some examples may involve one or more components within the arrangement of FIG. **2** being combined or further divided.

Within the arrangement of FIG. **2**, a control system, such as the remote master control system **262** or another component (e.g., a control system associated with the grid operator, the generation station control system **216**, or a datacenter control system associated with a traditional datacenter or one or more flexible datacenters) may use information to efficiently manage various operations of some of the components within the arrangement of FIG. **2**. For example, the remote master control system **262** or another component may manage distribution and execution of computational operations at one or more traditional datacenters **260** and/or flexible datacenters **220** via one or more information-processing algorithms. These algorithms may utilize past and current information in real-time to manage operations of the different components. These algorithms may also make some predictions based on past trends and information analysis. In some examples, multiple computing systems may operate as a network to process information.

Information used to make decisions may include economic and/or power-related information, such as monitored power system conditions. Monitored power system conditions may include one or more of excess power generation at a generation station **202**, excess power at a generation station **202** that a connected grid cannot receive, power generation at a generation station **202** subject to economic curtailment, power generation at a generation station **202** subject to reliability curtailment, power generation at a generation station **202** subject to power factor correction, low power generation at a generation station **202**, start up conditions at a generation station **202**, transient power generation conditions at a generation station **202**, or testing conditions where there is an economic advantage to using behind-the-meter power generation at a generation station **202**. These different monitored power system conditions can be weighted differently during processing and analysis.

In some examples, the information can include the cost for power from available sources (e.g., BTM power at the generation station **202** versus metered grid power) to enable comparisons to be made which power source costs less. In some instances, the information may include historic prices for power to enable the remote master control system **262** or another system to predict potential future prices in similar situations (e.g., the cost of power tends to trend upwards for grid power during warmer weather and peak-use hours). The information may also indicate the availability of power from the various sources (e.g., BTM power at the generation

station **262**, the energy storage system **218** at the generation station **262**, and/or metered grid power).

In addition, the information may also include other data, including information associated with operations at components within the arrangement. For instance, the information may include data associated with performance of operations at the flexible datacenters **220** and the traditional datacenters **260**, such as the number of computational tasks currently being performed, the types of tasks being performed (e.g., type of computational operation, time-sensitivity, etc.), the number, types, and capabilities of available computing systems, the amount of computational tasks awaiting performance, and the types of computing systems at one or more datacenters, among others. The information may also include data specifying the conditions at one or more datacenters (e.g., whether or not the temperatures are in a desired range, the amount of power available within an energy storage system such as **218**), the amount of computational tasks awaiting performance in the queue of one or more of the datacenters, and the identities of the entities associated with the computational operations at one or more of the datacenters. Entities associated with computational operations may be, for example, owners of the datacenters, customers who purchase computational time at the datacenters, or other entities.

The information used by the remote master control system **262** or another component may include data associated with the computational operations to be performed, such as deadlines, priorities (e.g., high vs. low priority tasks), cost to perform based on required computing systems, the optimal computing systems (e.g., CPU vs GPU vs ASIC; processing unit capabilities, speeds, or frequencies, or instructional sets executable by the processing units) for performing each requested computational task, and prices each entity (e.g., company) is willing to pay for computational operations to be performed or otherwise supported via computing systems at a traditional datacenter **260** or a flexible datacenter **220**, among others. In addition, the information may also include other data (e.g., weather conditions at locations of datacenters or power sources, any emergencies associated with a datacenter or power source, or the current value of bids associated with an auction for computational tasks).

The information may be updated in-real time and used to make the different operational decisions within the arrangement of FIG. **2**. For instance, the information may help a component (e.g., the remote master control system **262** or a control system at a flexible datacenter **220**) determine when to ramp up or ramp down power use at a flexible datacenter **220** or when to switch one or more computing systems at a flexible datacenter **220** into a low power mode or to operate at a different frequency, among other operational adjustments. The information can additionally or alternatively help a component within the arrangement of FIG. **2** to determine when to transfer computational operations between computing systems or between datacenters based on various factors. In some instances, the information may also be used to determine when to temporarily stop performing a computational operation or when to perform a computational operation at multiple sites for redundancy or other reasons. The information may further be used to determine when to accept new computational operations from entities or when to temporarily suspend accepting new tasks to be performed due to lack of computing system availability.

The remote master control system **262** represents a computing system that is capable of obtaining, managing, and using the information described above to manage and oversee one or more operations within the arrangement of FIG. **2**. As such, the remote master control system **262** may be one or more computing systems configured to process all, or a subset of, the information described above, such as power, environment, computational characterization, and economic factors to assist with the distribution and execution of computing operations among one or more datacenters. For instance, the remote master control system **262** may be configured to obtain and delegate computational operations among one or more datacenters based on a weighted analysis of a variety of factors, including one or more of the cost and availability of power, the types and availability of the computing systems at each datacenter, current and predicted weather conditions at the different locations of flexible datacenters (e.g., flexible datacenters **220**) and generation stations (e.g., generation stations **202**), levels of power storage available at one or more energy storage systems (e.g., energy storage system **218**), and deadlines and other attributes associated with particular computational operations, among other possible factors. As such, the analysis of information performed by the remote master control system **262** may vary within examples. For instance, the remote master control system **262** may use real-time information to determine whether or not to route a computational operation to a particular flexible datacenter (e.g., a flexible datacenter **220**) or to transition a computational operation between datacenters (e.g., from traditional datacenter **260** to a flexible datacenter **220**).

As shown in FIG. **2**, the generation station **202** may be able to supply power to the grid and/or BTM loads such as flexible datacenters **220**. With such a configuration, the generation station **202** may selectively provide power to the BTM loads and/or the grid based on economic and power availability considerations. For example, the generation station **202** may supply power to the grid when the price paid for the power exceeds a particular threshold (e.g., the power price offered by operators of the flexible datacenters **220**). In some instances, the operator of a flexible datacenter and the operator of a generation station capable of supplying BTM power to the flexible datacenter may utilize a predefined arrangement (e.g., a contract) that specifies a duration and/or price range when the generation station may supply power to the flexible datacenter.

The remote master control system **262** may be capable of directing one or more flexible datacenters **220** to ramp-up or ramp-down to desired power consumption levels, and/or to control cooperative action of multiple flexible datacenters by determining how to power each individual flexible datacenter **220** in accordance with operational directives.

The configuration of the remote master control system **262** can vary within examples as further discussed with respect to FIGS. **2**, **3**, and **7-9**. The remote master control system **262** may operate as a single computing system or may involve a network of computing systems. Preferably, the remote master control system **262** is implemented across one or more servers in a fault-tolerant operating environment that ensures continuous uptime and connectivity by virtue of its distributed nature. Alternatively, although the remote master control system **262** is shown as a physically separate component arrangement for FIG. **2**, the remote master control system **262** may be combined with another component in other embodiments. To illustrate an example, the remote master control system **262** may operate as part of a flexible datacenter (e.g., a computing system or a datacenter control system of the flexible datacenter **220**), includ-

ing sharing components with a flexible datacenter, sharing power with a flexible datacenter, and/or being co-located with a flexible datacenter.

In addition, the remote master control system **262** may communicate with components within the arrangement of FIG. **2** using various communication technologies, including wired and wireless communication technologies. For instance, the remote master control system **262** may use wired (not illustrated) or wireless communication to communicate with datacenter control systems or other computing systems at the flexible datacenters **220** and the traditional datacenters **260**. The remote master control system **262** may also communicate with entities inside or outside the arrangement of FIG. **2** and other components within the arrangement of FIG. **2** via wired or wireless communication. For instance, the remote master control system **262** may use wireless communication to obtain computational operations from entities seeking support for the computational operations at one or more datacenters in exchange for payment. The remote master control system **262** may communicate directly with the entities or may obtain the computational operations from the traditional datacenters **260**. For instance, an entity may submit jobs (e.g., computational operations) to one or more traditional datacenters **260**. The remote master control system **262** may determine that transferring one or more of the computational operations to a flexible datacenter **220** may better support the transferred computational operations. For example, the remote master control system **262** may determine that the transfer may enable the computational operations to be completed quicker and/or at a lower cost. In some examples, the remote master control system **262** may communicate with the entity to obtain approval prior to transferring the one or more computational operations.

The remote master control system **262** may also communicate with grid operators and/or an operator of generation station **202** to help determine power management strategies when distributing computational operations across the various datacenters. In addition, the remote master control system **262** may communicate with other sources, such as weather prediction systems, historical and current power price databases, and auction systems, etc.

In further examples, the remote master control system **262** or another computing system within the arrangement of FIG. **2** may use wired or wireless communication to submit bids within an auction that involves a bidder (e.g., the highest bid) obtaining computational operations or other tasks to be performed. Particularly, the remote master control system **262** may use the information discussed above to develop bids to obtain computing operations for performance at available computing systems at flexible datacenters (e.g., flexible datacenters **220**).

In the example arrangement shown in FIG. **2**, the flexible datacenters **220** represent example loads that can receive power behind-the-meter from the generation station **202**. In such a configuration, the flexible datacenters **220** may obtain and utilize power behind-the-meter from the generation station **202** to perform various computational operations. Performance of a computational operation may involve one or more computing systems providing resources useful in the computational operation. For instance, the flexible datacenters **220** may include one or more computing systems configured to store information, perform calculations and/or parallel processes, perform simulations, mine cryptocurrencies, and execute applications, among other potential tasks. The computing systems can be specialized or generic and can be arranged at each flexible datacenter **220** in a variety of ways (e.g., straight configuration, zig-zag configuration) as further discussed with respect to FIGS. **6**A, **6**B. Furthermore, although the example arrangement illustrated in FIG. **2** shows configurations where flexible datacenters **220** serve as BTM loads, other types of loads can be used as BTM loads within examples.

The arrangement of FIG. **2** includes the traditional datacenters **260** coupled to metered grid power. The traditional datacenters **260** using metered grid power to provide computational resources to support computational operations. One or more enterprises may assign computational operations to the traditional datacenters **260** with expectations that the datacenters reliably provide resources without interruption (i.e., non-intermittently) to support the computational operations, such as processing abilities, networking, and/or volatile storage. Similarly, one or more enterprises may also request computational operations to be performed by the flexible datacenters **220**. The flexible datacenters **220** differ from the traditional datacenters **260** in that the flexible datacenters **220** are arranged and/or configured to be connected to BTM power, are expected to operate intermittently, and are expected to ramp load (and thus computational capability) up or down regularly in response to control directives. In some examples, the flexible datacenters **220** and the traditional datacenters **260** may have similar configurations and may only differ based on the source(s) of power relied upon to power internal computing systems. Preferably, however, the flexible datacenters **220** include particular fast load ramping abilities (e.g., quickly increase or decrease power usage) and are intended and designed to effectively operate during intermittent periods of time.

FIG. **3** shows a block diagram of the remote master control system **300** according to one or more example embodiments. Remote master control system **262** may take the form of remote master control system **300**, or may include less than all components in remote master control system **300**, different components than in remote master control system **300**, and/or more components than in remote master control system **300**.

The remote master control system **300** may perform one or more operations described herein and may include a processor **302**, a data storage unit **304**, a communication interface **306**, a user interface **308**, an operations and environment analysis module **310**, and a queue system **312**. In other examples, the remote master control system **300** may include more or fewer components in other possible arrangements.

As shown in FIG. **3**, the various components of the remote master control system **300** can be connected via one or more connection mechanisms (e.g., a connection mechanism **314**). In this disclosure, the term "connection mechanism" means a mechanism that facilitates communication between two or more devices, systems, components, or other entities. For instance, a connection mechanism can be a simple mechanism, such as a cable, PCB trace, or system bus, or a relatively complex mechanism, such as a packet-based communication network (e.g., LAN, WAN, and/or the Internet). In some instances, a connection mechanism can include a non-tangible medium (e.g., where the connection is wireless).

As part of the arrangement of FIG. **2**, the remote master control system **300** (corresponding to remote master control system **262**) may perform a variety of operations, such as management and distribution of computational operations among datacenters, monitoring operational, economic, and environment conditions, and power management. For instance, the remote master control system **300** may obtain

computational operations from one or more enterprises for performance at one or more datacenters. The remote master control system **300** may subsequently use information to distribute and assign the computational operations to one or more datacenters (e.g., the flexible datacenters **220**) that have the resources (e.g., particular types of computing systems and available power) available to complete the computational operations. In some examples, the remote master control system **300** may assign all incoming computational operation requests to the queue system **312** and subsequently assign the queued requests to computing systems based on an analysis of current market and power conditions.

Although the remote master control system **300** is shown as a single entity, a network of computing systems may perform the operations of the remote master control system **300** in some examples. For example, the remote master control system **300** may exist in the form of computing systems (e.g., datacenter control systems) distributed across multiple datacenters.

The remote master control system **300** may include one or more processors **302**. As such, the processor **302** may represent one or more general-purpose processors (e.g., a microprocessor) and/or one or more special-purpose processors (e.g., a digital signal processor (DSP)). In some examples, the processor **302** may include a combination of processors within examples. The processor **302** may perform operations, including processing data received from the other components within the arrangement of FIG. **2** and data obtained from external sources, including information such as weather forecasting systems, power market price systems, and other types of sources or databases.

The data storage unit **304** may include one or more volatile, non-volatile, removable, and/or non-removable storage components, such as magnetic, optical, or flash storage, and/or can be integrated in whole or in part with the processor **302**. As such, the data storage unit **304** may take the form of a non-transitory computer-readable storage medium, having stored thereon program instructions (e.g., compiled or non-compiled program logic and/or machine code) that, when executed by the processor **302**, cause the remote master control system **300** to perform one or more acts and/or functions, such as those described in this disclosure. Such program instructions can define and/or be part of a discrete software application. In some instances, the remote master control system **300** can execute program instructions in response to receiving an input, such as from the communication interface **306**, the user interface **308**, or the operations and environment analysis module **310**. The data storage unit **304** may also store other information, such as those types described in this disclosure.

In some examples, the data storage unit **304** may serve as storage for information obtained from one or more external sources. For example, data storage unit **304** may store information obtained from one or more of the traditional datacenters **260**, a generation station **202**, a system associated with the grid, and flexible datacenters **220**. As examples only, data storage **304** may include, in whole or in part, local storage, dedicated server-managed storage, network attached storage, and/or cloud-based storage, and/or combinations thereof.

The communication interface **306** can allow the remote master control system **300** to connect to and/or communicate with another component according to one or more protocols. For instance, the communication interface **306** may be used to obtain information related to current, future, and past prices for power, power availability, current and predicted weather conditions, and information regarding the different datacenters (e.g., current workloads at datacenters, types of computing systems available within datacenters, price to obtain power at each datacenter, levels of power storage available and accessible at each datacenter, etc.). In an example, the communication interface **306** can include a wired interface, such as an Ethernet interface or a high-definition serial-digital-interface (HD-SDI). In another example, the communication interface **406** can include a wireless interface, such as a cellular, satellite, WiMAX, or WI-FI interface. A connection can be a direct connection or an indirect connection, the latter being a connection that passes through and/or traverses one or more components, such as such as a router, switcher, or other network device. Likewise, a wireless transmission can be a direct transmission or an indirect transmission. The communication interface **306** may also utilize other types of wireless communication to enable communication with datacenters positioned at various locations.

The communication interface **306** may enable the remote master control system **300** to communicate with the components of the arrangement of FIG. **2**. In addition, the communication interface **306** may also be used to communicate with the various datacenters, power sources, and different enterprises submitting computational operations for the datacenters to support.

The user interface **308** can facilitate interaction between the remote master control system **300** and an administrator or user, if applicable. As such, the user interface **308** can include input components such as a keyboard, a keypad, a mouse, a touch-sensitive panel, a microphone, and/or a camera, and/or output components such as a display device (which, for example, can be combined with a touch-sensitive panel), a sound speaker, and/or a haptic feedback system. More generally, the user interface **308** can include hardware and/or software components that facilitate interaction between remote master control system **300** and the user of the system.

In some examples, the user interface **308** may enable the manual examination and/or manipulation of components within the arrangement of FIG. **2**. For instance, an administrator or user may use the user interface **308** to check the status of, or change, one or more computational operations, the performance or power consumption at one or more datacenters, the number of tasks remaining within the queue system **312**, and other operations. As such, the user interface **308** may provide remote connectivity to one or more systems within the arrangement of FIG. **2**.

The operations and environment analysis module **310** represents a component of the remote master control system **300** associated with obtaining and analyzing information to develop instructions/directives for components within the arrangement of FIG. **2**. The information analyzed by the operations and environment analysis module **310** can vary within examples and may include the information described above with respect predicting and/or directing the use of BTM power. For instance, the operations and environment analysis module **310** may obtain and access information related to the current power state of computing systems operating as part of the flexible datacenters **220** and other datacenters that the remote master control system **300** has access to. This information may be used to determine when to adjust power usage or mode of one or more computing systems. In addition, the remote master control system **300** may provide instructions a flexible datacenter **220** to cause a subset of the computing systems to transition into a low power mode to consume less power while still performing

operations at a slower rate. The remote master control system **300** may also use power state information to cause a set of computing systems at a flexible datacenter **220** to operate at a higher power consumption mode. In addition, the remote master control system **300** may transition computing systems into sleep states or power on/off based on information analyzed by the operations and environment analysis module **310**.

In some examples, the operations and environment analysis module **310** may use location, weather, activity levels at the flexible datacenters or the generation station, and power cost information to determine control strategies for one or more components in the arrangement of FIG. **2**. For instance, the remote master control system **300** may use location information for one or more datacenters to anticipate potential weather conditions that could impact access to power. In addition, the operations and environment analysis module **310** may assist the remote master control system **300** determine whether to transfer computational operations between datacenters based on various economic and power factors.

The queue system **312** represents a queue capable of organizing computational operations to be performed by one or more datacenters. Upon receiving a request to perform a computational operation, the remote master control system **300** may assign the computational operation to the queue until one or more computing systems are available to support the computational operation. The queue system **312** may be used for organizing and transferring computational tasks in real time.

The organizational design of the queue system **312** may vary within examples. In some examples, the queue system **312** may organize indications (e.g., tags, pointers) to sets of computational operations requested by various enterprises. The queue system **312** may operate as a First-In-First-Out (FIFO) data structure. In a FIFO data structure, the first element added to the queue will be the first one to be removed. As such, the queue system **312** may include one or more queues that operate using the FIFO data structure.

In some examples, one or more queues within the queue system **312** may use other designs of queues, including rules to rank or organize queues in a particular manner that can prioritize some sets of computational operations over others. The rules may include one or more of an estimated cost and/or revenue to perform each set of computational operations, an importance assigned to each set of computational operations, and deadlines for initiating or completing each set of computational operations, among others. Examples using a queue system are further described below with respect to FIG. **9**.

In some examples, the remote master control system **300** may be configured to monitor one or more auctions to obtain computational operations for datacenters to support. Particularly, the remote master control system **300** may use resource availability and power prices to develop and submit bids to an external or internal auction system for the right to support particular computational operations. As a result, the remote master control system **300** may identify computational operations that could be supported at one or more flexible datacenters **220** at low costs.

FIG. **4** is a block diagram of a generation station **400**, according to one or more example embodiments. Generation station **202** may take the form of generation station **400**, or may include less than all components in generation station **400**, different components than in generation station **400**, and/or more components than in generation station **400**. The generation station **400** includes power generation equipment **401**, a communication interface **408**, a behind-the-meter interface **406**, a grid interface **404**, a user interface **410**, a generation station control system **414**, and power transformation equipment **402**. The power generation equipment **210** may take the form of power generation equipment **401**, or may include less than all components in power generation equipment **401**, different components than in power generation equipment **401**, and/or more components than in power generation equipment **401**. Generation station control system **216** may take the form of generation station control system **414**, or may include less than all components in generation station control system **414**, different components than in generation station control system **414**, and/or more components than in generation station control system **414**. Some or all of the components generation station **400** may be connected via a communication interface **516**. These components are illustrated in FIG. **4** to convey an example configuration for the generation station **400** (corresponding to generation station **202** shown in FIG. **2**). In other examples, the generation station **400** may include more or fewer components in other arrangements.

The generation station **400** can correspond to any type of grid-connected utility-scale power producer capable of supplying power to one or more loads. The size, amount of power generated, and other characteristics of the generation station **400** may differ within examples. For instance, the generation station **400** may be a power producer that provides power intermittently. The power generation may depend on monitored power conditions, such as weather at the location of the generation station **400** and other possible conditions. As such, the generation station **400** may be a temporary arrangement, or a permanent facility, configured to supply power. The generation station **400** may supply BTM power to one or more loads and supply metered power to the electrical grid. Particularly, the generation station **400** may supply power to the grid as shown in the arrangement of FIG. **2**.

The power generation equipment **401** represents the component or components configured to generate utility-scale power. As such, the power generation equipment **401** may depend on the type of facility that the generation station **400** corresponds to. For instance, the power generation equipment **401** may correspond to electric generators that transform kinetic energy into electricity. The power generation equipment **401** may use electromagnetic induction to generate power. In other examples, the power generation equipment **401** may utilize electrochemistry to transform chemical energy into power. The power generation equipment **401** may use the photovoltaic effect to transform light into electrical energy. In some examples, the power generation equipment **401** may use turbines to generate power. The turbines may be driven by, for example, wind, water, steam or burning gas. Other examples of power production are possible.

The communication interface **408** can enable the generation station **400** to communicate with other components within the arrangement of FIG. **2**. As such, the communication interface **408** may operate similarly to the communication interface **306** of the remote master control system **300** and the communication interface **503** of the flexible datacenter **500**.

The generation station control system **414** may be one or more computing systems configured to control various aspects of the generation station **400**.

The BTM interface **406** is a module configured to enable the power generation equipment **401** to supply BTM power to one or more loads and may include multiple components.

The arrangement of the BTM interface **406** may differ within examples based on various factors, such as the number of flexible datacenters **220** (or **500**) coupled to the generation station **400**, the proximity of the flexible datacenters **220** (or **500**), and the type of generation station **400**, among others. In some examples, the BTM interface **406** may be configured to enable power delivery to one or more flexible datacenters positioned near the generation station **400**. Alternatively, the BTM interface **406** may also be configured to enable power delivery to one or more flexible datacenters **220** (or **500**) positioned remotely from the generation station **400**.

The grid interface **404** is a module configured to enable the power generation equipment **401** to supply power to the grid and may include multiple components. As such, the grid interface **404** may couple to one or more transmission lines (e.g., transmission lines **404***a* shown in FIG. **2**) to enable delivery of power to the grid.

The user interface **410** represents an interface that enables administrators and/or other entities to communicate with the generation station **400**. As such, the user interface **410** may have a configuration that resembles the configuration of the user interface **308** shown in FIG. **3**. An operator may utilize the user interface **410** to control or monitor operations at the generation station **400**.

The power transformation equipment **402** represents equipment that can be utilized to enable power delivery from the power generation equipment **401** to the loads and to transmission lines linked to the grid. Example power transformation equipment **402** includes, but is not limited to, transformers, inverters, phase converters, and power conditioners.

FIG. **5** shows a block diagram of a flexible datacenter **500**, according to one or more example embodiments. Flexible datacenters **220** may take the form of flexible datacenter **500**, or may include less than all components in flexible datacenter **500**, different components than in flexible datacenter **500**, and/or more components than in flexible datacenter **500**. In the example embodiment shown in FIG. **5**, the flexible datacenter **500** includes a power input system **502**, a communication interface **503**, a datacenter control system **504**, a power distribution system **506**, a climate control system **508**, one or more sets of computing systems **512**, and a queue system **514**. These components are shown connected by a communication bus **528**. In other embodiments, the configuration of flexible datacenter **500** can differ, including more or fewer components. In addition, the components within flexible datacenter **500** may be combined or further divided into additional components within other embodiments.

The example configuration shown in FIG. **5** represents one possible configuration for a flexible datacenter. As such, each flexible datacenter may have a different configuration when implemented based on a variety of factors that may influence its design, such as location and temperature that the location, particular uses for the flexible datacenter, source of power supplying computing systems within the flexible datacenter, design influence from an entity (or entities) that implements the flexible datacenter, and space available for the flexible datacenter. Thus, the embodiment of flexible datacenter **220** shown in FIG. **2** represents one possible configuration for a flexible datacenter out of many other possible configurations.

The flexible datacenter **500** may include a design that allows for temporary and/or rapid deployment, setup, and start time for supporting computational operations. For instance, the flexible datacenter **500** may be rapidly deployed at a location near a source of generation station power (e.g., near a wind farm or solar farm). Rapid deployment may involve positioning the flexible datacenter **500** at a target location and installing and/or configuring one or more racks of computing systems within. The racks may include wheels to enable swift movement of the computing systems. Although the flexible datacenter **500** could theoretically be placed anywhere, transmission losses may be minimized by locating it proximate to BTM power generation.

The physical construction and layout of the flexible datacenter **500** can vary. In some instances, the flexible datacenter **500** may utilize a metal container (e.g., a metal container **602** shown in FIG. **6**A). In general, the flexible datacenter **500** may utilize some form of secure weatherproof housing designed to protect interior components from wind, weather, and intrusion. The physical construction and layout of example flexible datacenters are further described with respect to FIGS. **6**A-**6**B.

Within the flexible datacenter **500**, various internal components enable the flexible datacenter **500** to utilize power to perform some form of operations. The power input system **502** is a module of the flexible datacenter **500** configured to receive external power and input the power to the different components via assistance from the power distribution system **506**. As discussed with respect to FIG. **2**, the sources of external power feeding a flexible datacenter can vary in both quantity and type (e.g., the generation stations **202**, **400**, grid-power, energy storage systems). Power input system **502** includes a BTM power input sub-system **522**, and may additionally include other power input sub-systems (e.g., a grid-power input sub-system **524** and/or an energy storage input sub-system **526**). In some instances, the quantity of power input sub-systems may depend on the size of the flexible datacenter and the number and/or type of computing systems being powered. In an example embodiment, the flexible datacenter may use grid power as the primary power supply.

In some embodiments, the power input system **502** may include some or all of flexible datacenter Power Equipment **220**B. The power input system **502** may be designed to obtain power in different forms (e.g., single phase or three-phase behind-the-meter alternating current ("AC") voltage, and/or direct current ("DC") voltage). As shown, the power input system **502** includes a BTM power input sub-system **522**, a grid power input sub-system **524**, and an energy input sub-system **526**. These sub-systems are included to illustrate example power input sub-systems that the flexible datacenter **500** may utilize, but other examples are possible. In addition, in some instances, these sub-systems may be used simultaneously to supply power to components of the flexible datacenter **500**. The sub-systems may also be used based on available power sources.

In some implementations, the BTM power input sub-system **522** may include one or more AC-to-AC step-down transformers used to step down supplied medium-voltage AC to low voltage AC (e.g., 120V to 600V nominal) used to power computing systems **512** and/or other components of flexible datacenter **500**. The power input system **502** may also directly receive single-phase low voltage AC from a generation station as BTM power, from grid power, or from a stored energy system such as energy storage system **218**. In some implementations, the power input system **502** may provide single-phase AC voltage to the datacenter control system **504** (and/or other components of flexible datacenter **500**) independent of power supplied to computing systems **512** to enable the datacenter control system **504** to perform

management operations for the flexible datacenter **500**. For instance, the grid power input sub-system **524** may use grid power to supply power to the datacenter control system **504** to ensure that the datacenter control system **504** can perform control operations and communicate with the remote master control system **300** (or **262**) during situations when BTM power is not available. As such, the datacenter control system **504** may utilize power received from the power input system **502** to remain powered to control the operation of flexible datacenter **500**, even if the computational operations performed by the computing system **512** are powered intermittently. In some instances, the datacenter control system **504** may switch into a lower power mode to utilize less power while still maintaining the ability to perform some functions.

The power distribution system **506** may distribute incoming power to the various components of the flexible datacenter **500**. For instance, the power distribution system **506** may direct power (e.g., single-phase or three-phase AC) to one or more components within flexible datacenter **500**. In some embodiments, the power distribution system **506** may include some or all of flexible datacenter Power Equipment **220**B.

In some examples, the power input system **502** may provide three phases of three-phase AC voltage to the power distribution system **506**. The power distribution system **506** may controllably provide a single phase of AC voltage to each computing system or groups of computing systems **512** disposed within the flexible datacenter **500**. The datacenter control system **504** may controllably select which phase of three-phase nominal AC voltage that power distribution system **506** provides to each computing system **512** or groups of computing systems **512**. This is one example manner in which the datacenter control system **504** may modulate power delivery (and load at the flexible datacenter **500**) by ramping-up flexible datacenter **500** to fully operational status, ramping-down flexible datacenter **500** to offline status (where only datacenter control system **504** remains powered), reducing load by withdrawing power delivery from, or reducing power to, one or more of the computing systems **512** or groups of the computing systems **512**, or modulating power factor correction for the generation station **300** (or **202**) by controllably adjusting which phases of three-phase nominal AC voltage are used by one or more of the computing systems **512** or groups of the computing systems **512**. The datacenter control system **504** may direct power to certain sets of computing systems based on computational operations waiting for computational resources within the queue system **514**. In some embodiments, the flexible datacenter **500** may receive BTM DC power to power the computing systems **512**.

One of ordinary skill in the art will recognize that a voltage level of three-phase AC voltage may vary based on an application or design and the type or kind of local power generation. As such, a type, kind, or configuration of the operational AC-to-AC step down transformer (not shown) may vary based on the application or design. In addition, the frequency and voltage level of three-phase AC voltage, single-phase AC voltage, and DC voltage may vary based on the application or design in accordance with one or more embodiments.

As discussed above, the datacenter control system **504** may perform operations described herein, such as dynamically modulating power delivery to one or more of the computing systems **512** disposed within flexible datacenter **500**. For instance, the datacenter control system **504** may modulate power delivery to one or more of the computing systems **512** based on various factors, such as BTM power availability or an operational directive from a generation station **262** or **300** control system, a remote master control system **262** or **300**, or a grid operator. In some examples, the datacenter control system **504** may provide computational operations to sets of computing systems **512** and modulate power delivery based on priorities assigned to the computational operations. For instance, an important computational operation (e.g., based on a deadline for execution and/or price paid by an entity) may be assigned to a particular computing system or set of computing systems **512** that has the capacity, computational abilities to support the computational operation. In addition, the datacenter control system **504** may also prioritize power delivery to the computing system or set of computing systems **512**.

In some example, the datacenter control system **504** may further provide directives to one or more computing systems to change operations in some manner. For instance, the datacenter control system **504** may cause one or more computing systems **512** to operate at a lower or higher frequency, change clock cycles, or operate in a different power consumption mode (e.g., a low power mode). These abilities may vary depending on types of computing systems **512** available at the flexible datacenter **500**. As a result, the datacenter control system **504** may be configured to analyze the computing systems **512** available either on a periodic basis (e.g., during initial set up of the flexible datacenter **500**) or in another manner (e.g., when a new computational operation is assigned to the flexible datacenter **500**).

The datacenter control system **504** may also implement directives received from the remote master control system **262** or **300**. For instance, the remote master control system **262** or **300** may direct the flexible datacenter **500** to switch into a low power mode. As a result, one or more of the computing systems **512** and other components may switch to the low power mode in response.

The datacenter control system **504** may utilize the communication interface **503** to communicate with the remote master control system **262** or **300**, other datacenter control systems of other datacenters, and other entities. As such, the communication interface **503** may include components and operate similar to the communication interface **306** of the remote master control system **300** described with respect to FIG. **4**.

The flexible datacenter **500** may also include a climate control system **508** to maintain computing systems **512** within a desired operational temperature range. The climate control system **508** may include various components, such as one or more air intake components, an evaporative cooling system, one or more fans, an immersive cooling system, an air conditioning or refrigerant cooling system, and one or more air outtake components. One of ordinary skill in the art will recognize that any suitable heat extraction system configured to maintain the operation of computing systems **512** within the desired operational temperature range may be used.

The flexible datacenter **500** may further include an energy storage system **510**. The energy storage system **510** may store energy for subsequent use by computing systems **512** and other components of flexible datacenter **500**. For instance, the energy storage system **510** may include a battery system. The battery system may be configured to convert AC voltage to DC voltage and store power in one or more storage cells. In some instances, the battery system may include a DC-to-AC inverter configured to convert DC

voltage to AC voltage, and may further include an AC phase-converter, to provide AC voltage for use by flexible datacenter **500**.

The energy storage system **510** may be configured to serve as a backup source of power for the flexible datacenter **500**. For instance, the energy storage system **510** may receive and retain power from a BTM power source at a low cost (or no cost at all). This low-cost power can then be used by the flexible datacenter **500** at a subsequent point, such as when BTM power costs more. Similarly, the energy storage system **510** may also store energy from other sources (e.g., grid power). As such, the energy storage system **510** may be configured to use one or more of the sub-systems of the power input system **502**.

In some examples, the energy storage system **510** may be external to the flexible datacenter **500**. For instance, the energy storage system **510** may be an external source that multiple flexible datacenters utilize for back-up power.

The computing systems **512** represent various types of computing systems configured to perform computational operations. Performance of computational operations include a variety of tasks that one or more computing systems may perform, such as data storage, calculations, application processing, parallel processing, data manipulation, cryptocurrency mining, and maintenance of a distributed ledger, among others. As shown in FIG. **5**, the computing systems **512** may include one or more CPUs **516**, one or more GPUs **518**, and/or one or more Application-Specific Integrated Circuits (ASIC's) **520**. Each type of computing system **512** may be configured to perform particular operations or types of operations.

Due to different performance features and abilities associated with the different types of computing systems, the datacenter control system **504** may determine, maintain, and/or relay this information about the types and/or abilities of the computing systems, quantity of each type, and availability to the remote master control system **262** or **300** on a routine basis (e.g., periodically or on-demand). This way, the remote master control system **262** or **300** may have current information about the abilities of the computing systems **512** when distributing computational operations for performance at one or more flexible datacenters. Particularly, the remote master control system **262** or **300** may assign computational operations based on various factors, such as the types of computing systems available and the type of computing systems required by each computing operation, the availability of the computing systems, whether computing systems can operate in a low power mode, and/or power consumption and/or costs associated with operating the computing systems, among others.

The quantity and arrangement of these computing systems **512** may vary within examples. In some examples, the configuration and quantity of computing systems **512** may depend on various factors, such as the computational tasks that are performed by the flexible datacenter **500**. In other examples, the computing systems **512** may include other types of computing systems as well, such as DSPs, SIMDs, neural processors, and/or quantum processors.

As indicated above, the computing systems **512** can perform various computational operations, including in different configurations. For instance, each computing system may perform a particular computational operation unrelated to the operations performed at other computing systems. Groups of the computing systems **512** may also be used to work together to perform computational operations.

In some examples, multiple computing systems may perform the same computational operation in a redundant configuration. This redundant configuration creates a back-up that prevents losing progress on the computational operation in situations of a computing failure or intermittent operation of one or more computing systems. In addition, the computing systems **512** may also perform computational operations using a check point system. The check point system may enable a first computing system to perform operations up to a certain point (e.g., a checkpoint) and switch to a second computing system to continue performing the operations from that certain point. The check point system may also enable the datacenter control system **504** to communicate statuses of computational operations to the remote master control system **262** or **300**. This can further enable the remote master control system **262 300** to transfer computational operations between different flexible datacenters allowing computing systems at the different flexible datacenters to resume support of computational operations based on the check points.

The queue system **514** may operate similar to the queue system **312** of the remote master control system **300** shown in FIG. **3**. Particularly, the queue system **514** may help store and organize computational tasks assigned for performance at the flexible datacenter **500**. In some examples, the queue system **514** may be part of a distributed queue system such that each flexible datacenter in a fleet of flexible datacenter includes a queue, and each queue system **514** may be able to communicate with other queue systems. In addition, the remote master control system **262** or **300** may be configured to assign computational tasks to the queues located at each flexible datacenter (e.g., the queue system **514** of the flexible datacenter **500**). As such, communication between the remote master control system **262** or **300** and the datacenter control system **504** and/or the queue system **514** may allow organization of computational operations for the flexible datacenter **500** to support.

FIG. **6**A shows another structural arrangement for a flexible datacenter, according to one or more example embodiments. The particular structural arrangement shown in FIG. **6**A may be implemented at flexible datacenter **500**. The illustration depicts the flexible datacenter **500** as a mobile container **702** equipped with the power input system **502**, the power distribution system **506**, the climate control system **508**, the datacenter control system **504**, and the computing systems **512** arranged on one or more racks **604**. These components of flexible datacenter **500** may be arranged and organized according to an example structural region arrangement. As such, the example illustration represents one possible configuration for the flexible datacenter **500**, but others are possible within examples.

As discussed above, the structural arrangement of the flexible datacenter **500** may depend on various factors, such as the ability to maintain temperature within the mobile container **602** within a desired temperature range. The desired temperature range may depend on the geographical location of the mobile container **602** and the type and quantity of the computing systems **512** operating within the flexible datacenter **500** as well as other possible factors. As such, the different design elements of the mobile container **602** including the inner contents and positioning of components may depend on factors that aim to maximize the use of space within mobile container **602**, lower the amount of power required to cool the computing systems **512**, and make setup of the flexible datacenter **500** efficient. For instance, a first flexible datacenter positioned in a cooler geographic region may include less cooling equipment than a second flexible datacenter positioned in a warmer geographic region.

As shown in FIG. **6**A, the mobile container **602** may be a storage trailer disposed on permanent or removable wheels and configured for rapid deployment. In other embodiments, the mobile container **602** may be a storage container (not shown) configured for placement on the ground and potentially stacked in a vertical or horizontal manner (not shown). In still other embodiments, the mobile container **602** may be an inflatable container, a floating container, or any other type or kind of container suitable for housing a mobile flexible datacenter. As such, the flexible datacenter **500** may be rapidly deployed on site near a source of unutilized behind-the-meter power generation. And in still other embodiments, the flexible datacenter **500** might not include a mobile container. For example, the flexible datacenter **500** may be situated within a building or another type of stationary environment.

FIG. **6**B shows the computing systems **512** in a straight-line configuration for installation within the flexible datacenter **500**, according to one or more example embodiments. As indicated above, the flexible datacenter **500** may include a plurality of racks **604**, each of which may include one or more computing systems **512** disposed therein. As discussed above, the power input system **502** may provide three phases of AC voltage to the power distribution system **506**. In some examples, the power distribution system **506** may controllably provide a single phase of AC voltage to each computing system **512** or group of computing systems **512** disposed within the flexible datacenter **500**. As shown in FIG. **6**B, for purposes of illustration only, eighteen total racks **604** are divided into a first group of six racks **606**, a second group of six racks **608**, and a third group of six racks **610**, where each rack contains eighteen computing systems **512**. The power distribution system (**506** of FIG. **5**) may, for example, provide a first phase of three-phase AC voltage to the first group of six racks **606**, a second phase of three-phase AC voltage to the second group of six racks **608**, and a third phase of three-phase AC voltage to the third group of six racks **610**. In other embodiments, the quantity of racks and computing systems can vary.

FIG. **7** shows a control distribution system **700** of the flexible datacenter **500** according to one or more example embodiments. The system **700** includes a grid operator **702**, a generation station control system **216**, a remote master control system **300**, and a flexible datacenter **500**. As such, the system **700** represents one example configuration for controlling operations of the flexible datacenter **500**, but other configurations may include more or fewer components in other arrangements.

The datacenter control system **504** may independently or cooperatively with one or more of the generation station control system **414**, the remote master control system **300**, and/or the grid operator **702** modulate power at the flexible datacenter **500**. During operations, the power delivery to the flexible datacenter **500** may be dynamically adjusted based on conditions or operational directives. The conditions may correspond to economic conditions (e.g., cost for power, aspects of computational operations to be performed), power-related conditions (e.g., availability of the power, the sources offering power), demand response, and/or weather-related conditions, among others.

The generation station control system **414** may be one or more computing systems configured to control various aspects of a generation station (not independently illustrated, e.g., **216** or **400**). As such, the generation station control system **414** may communicate with the remote master control system **300** over a networked connection **706** and with the datacenter control system **704** over a networked or other data connection **708**.

As discussed with respect to FIGS. **2** and **3**, the remote master control system **300** can be one or more computing systems located offsite, but connected via a network connection **710** to the datacenter control system **504**. The remote master control system **300** may provide supervisory controls or override control of the flexible datacenter **500** or a fleet of flexible datacenters (not shown).

The grid operator **702** may be one or more computing systems that are configured to control various aspects of the power grid (not independently illustrated) that receives power from the generation station. The grid operator **702** may communicate with the generation station control system **300** over a networked or other data connection **712**.

The datacenter control system **504** may monitor BTM power conditions at the generation station and determine when a datacenter ramp-up condition is met. The BTM power availability may include one or more of excess local power generation, excess local power generation that the grid cannot accept, local power generation that is subject to economic curtailment, local power generation that is subject to reliability curtailment, local power generation that is subject to power factor correction, conditions where the cost for power is economically viable (e.g., low cost to obtain power), low priced power, situations where local power generation is prohibitively low, start up situations, transient situations, or testing situations where there is an economic advantage to using locally generated behind-the-meter power generation, specifically power available at little to no cost and with no associated transmission or distribution losses or costs. For example, a datacenter control system may analyze future workload and near term weather conditions at the flexible datacenter.

In some instances, the datacenter ramp-up condition may be met if there is sufficient behind-the-meter power availability and there is no operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702** to go offline or reduce power. As such, the datacenter control system **504** may enable 714 the power input system **502** to provide power to the power distribution system **506** to power the computing systems **512** or a subset thereof.

The datacenter control system **504** may optionally direct one or more computing systems **512** to perform predetermined computational operations (e.g., distributed computing processes). For example, if the one or more computing systems **512** are configured to perform blockchain hashing operations, the datacenter control system **504** may direct them to perform blockchain hashing operations for a specific blockchain application, such as, for example, Bitcoin, Litecoin, or Ethereum. Alternatively, one or more computing systems **512** may be configured to perform high-throughput computing operations and/or high performance computing operations.

The remote master control system **300** may specify to the datacenter control system **504** what sufficient behind-the-meter power availability constitutes, or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently. For example, in certain circumstances, sufficient behind-the-meter power availability may be less than that required to fully power the entire flexible datacenter **500**. In such circumstances, the datacenter control system **504** may provide power to only a subset of computing systems, or operate the plurality of computing systems in a

lower power mode, that is within the sufficient, but less than full, range of power that is available. In addition, the computing systems **512** may adjust operational frequency, such as performing more or less processes during a given duration. The computing systems **512** may also adjust internal clocks via over-clocking or under-clocking when performing operations.

While the flexible datacenter **500** is online and operational, a datacenter ramp-down condition may be met when there is insufficient or anticipated to be insufficient, behind-the-meter power availability or there is an operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. The datacenter control system **504** may monitor and determine when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability. As noted above, sufficiency may be specified by the remote master control system **300** or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently.

An operational directive may be based on current dispatch-ability, forward looking forecasts for when behind-the-meter power is, or is expected to be, available, economic considerations, reliability considerations, operational considerations, or the discretion of the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. For example, the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may issue an operational directive to flexible datacenter **500** to go offline and power down. When the datacenter ramp-down condition is met, the datacenter control system **504** may disable power delivery to the plurality of computing systems (e.g., **512**). The datacenter control system **504** may disable **714** the power input system **502** from providing power (e.g., three-phase nominal AC voltage) to the power distribution system **506** to power down the computing systems **512** while the datacenter control system **504** remains powered and is capable of returning service to operating mode at the flexible datacenter **500** when behind-the-meter power becomes available again.

While the flexible datacenter **500** is online and operational, changed conditions or an operational directive may cause the datacenter control system **504** to modulate power consumption by the flexible datacenter **500**. The datacenter control system **504** may determine, or the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in less power generation, availability, or economic feasibility, than would be necessary to fully power the flexible datacenter **500**. In such situations, the datacenter control system **504** may take steps to reduce or stop power consumption by the flexible datacenter **500** (other than that required to maintain operation of datacenter control system **504**).

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to reduce power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically reduce or withdraw power delivery to one or more computing systems **512** to meet the dictate. The datacenter control system **504** may controllably provide three-phase nominal AC voltage to a smaller subset of computing systems (e.g., **512**) to reduce power consumption. The datacenter control system **504** may dynamically reduce the power consumption of one or more computing systems by reducing their operating frequency or forcing them into a lower power mode through a network directive.

Similarly, the flexible datacenter **500** may ramp up power consumption based on various conditions. For instance, the datacenter control system **504** may determine, or the generation control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in greater power generation, availability, or economic feasibility. In such situations, the datacenter control system **504** may take steps to increase power consumption by the flexible datacenter **500**.

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to increase power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically increase power delivery to one or more computing systems **512** (or operations at the computing systems **512**) to meet the dictate. For instance, one or more computing systems **512** may transition into a higher power mode, which may involve increasing power consumption and/or operation frequency.

One of ordinary skill in the art will recognize that datacenter control system **504** may be configured to have a number of different configurations, such as a number or type or kind of the computing systems **512** that may be powered, and in what operating mode, that correspond to a number of different ranges of sufficient and available behind-the-meter power. As such, the datacenter control system **504** may modulate power delivery over a variety of ranges of sufficient and available unutilized behind-the-meter power availability.

FIG. **8** shows a control distribution system **800** of a fleet of flexible datacenters according to one or more example embodiments. The control distribution system **800** of the flexible datacenter **500** shown and described with respect to FIG. **7** may be extended to a fleet of flexible datacenters as illustrated in FIG. **8**. For example, a first generation station (not independently illustrated), such as a wind farm, may include a first plurality of flexible datacenters **802**, which may be collocated or distributed across the generation station. A second generation station (not independently illustrated), such as another wind farm or a solar farm, may include a second plurality of flexible datacenters **804**, which may be collocated or distributed across the generation station. One of ordinary skill in the art will recognize that the number of flexible datacenters deployed at a given station and the number of stations within the fleet may vary based on an application or design in accordance with one or more example embodiments.

The remote master control system **300** may provide directive to datacenter control systems of the fleet of flexible datacenters in a similar manner to that shown and described with respect to FIG. **7**, with the added flexibility to make high level decisions with respect to fleet that may be counterintuitive to a given station. The remote master control system **300** may make decisions regarding the issuance of operational directives to a given generation station based on, for example, the status of each generation station where flexible datacenters are deployed, the workload distributed across fleet, and the expected computational demand required for one or both of the expected workload and predicted power availability. In addition, the remote master control system **300** may shift workloads from the first plurality of flexible datacenters **802** to the second plurality of flexible datacenters **804** for any reason, including, for

example, a loss of BTM power availability at one generation station and the availability of BTM power at another generation station. As such, the remote master control system **300** may communicate with the generation station control systems **806**A, **806**B to obtain information that can be used to organize and distribute computational operations to the fleets of flexible datacenters **802**, **804**.

FIG. **9** shows a queue distribution arrangement for a traditional datacenter **902** and a flexible datacenter **500**, according to one or more example embodiments. The arrangement of FIG. **9** includes a flexible datacenter **500**, a traditional datacenter **902**, a queue system **312**, a set of communication links **916**, **918**, **920**A, **920**B, and the remote master control system **300**. The arrangement of FIG. **9** represents an example configuration scheme that can be used to distribute computing operations using a queue system **312** between the traditional datacenter **902** and one or more flexible datacenters. In other examples, the arrangement of FIG. **9** may include more or fewer components in other potential configurations. For instance, the arrangement of FIG. **9** may not include the queue system **312** or may include routes that bypass the queue system **312**.

The arrangement of FIG. **9** may enable computational operations requested to be performed by entities (e.g., companies). As such, the arrangement of FIG. **9** may use the queue system **312** to organize incoming computational operations requests to enable efficient distribution to the flexible datacenter **500** and the critical traditional datacenter **902**. Particularly, the arrangement of FIG. **9** may use the queue system **312** to organize sets of computational operations thereby increasing the speed of distribution and performance of the different computational operations among datacenters. As a result, the use of the queue system **312** may reduce time to complete operations and reduce costs.

In some examples, one or more components, such as the datacenter control system **504**, the remote master control system **300**, the queue system **312**, or the control system **936**, may be configured to identify situations that may arise where using the flexible datacenter **500** can reduce costs or increase productivity of the system, as compared to using the traditional datacenter **902** for computational operations. For example, a component within the arrangement of FIG. **9** may identify when using behind-the-meter power to power the computing systems **512** within the flexible datacenter **500** is at a lower cost compared to using the computing systems **934** within the traditional datacenter **902** that are powered by grid power. Additionally, a component in the arrangement of FIG. **9** may be configured to determine situations when offloading computational operations from the traditional datacenter **902** indirectly (i.e., via the queue system **312**) or directly (i.e., bypassing the queue system **312**) to the flexible datacenter **500** can increase the performance allotted to the computational operations requested by an entity (e.g., reduce the time required to complete time-sensitive computational operations).

In some examples, the datacenter control system **504** may monitor activity of the computing systems **512** within the flexible datacenter **500** and use the respective activity levels to determine when to obtain computational operations from the queue system **312**. For instance, the datacenter control system **504** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **512** to perform. The various factors may include power availability at the flexible datacenter **500** (e.g., either stored or from a BTM source), availability of the computing systems **512** (e.g., percentage of computing systems available), type of computational operations available, estimated cost to perform the computational operations at the flexible datacenter **500**, cost for power, cost for power relative to cost for grid power, and instructions from other components within the system, among others. The datacenter control system **504** may analyze one or more of the factors when determining whether to obtain a new set of computational operations for the computing systems **512** to perform. In such a configuration, the datacenter control system **504** manages the activity of the flexible datacenter **500**, including determining when to acquire new sets of computational operations when capacity among the computing systems **512** permit.

In other examples, a component (e.g., the remote master control system **300**) within the system may assign or distribute one or more sets of computational operations organized by the queue system **312** to the flexible datacenter **500**. For example, the remote master control system **300** may manage the queue system **312**, including the distribution of computational operations organized by the queue system **312** to the flexible datacenter **500** and the traditional datacenter **902**. The remote master control system **300** may utilize to information described with respect to the Figures above to determine when to assign computational operations to the flexible datacenter **500**.

The traditional datacenter **902** may include a power input system **930**, a power distribution system **932**, a datacenter control system **936**, and a set of computing systems **934**. The power input system **930** may be configured to receive power from a power grid and distribute the power to the computing systems **934** via the power distribution system **932**. The datacenter control system **936** may monitor activity of the computing systems **934** and obtain computational operations to perform from the queue system **312**. The datacenter control system **936** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **934** to perform. A component (e.g., the remote master control system **300**) within the arrangement of FIG. **9** may assign or distribute one or more sets of computational operations organized by the queue system **312** to the traditional datacenter **902**.

The communication link **916** represents one or more links that may serve to connect the flexible datacenter **500**, the traditional datacenter **902**, and other components within the system (e.g., the remote master control system **300**, the queue system **312**—connections not shown). In particular, the communication link **916** may enable direct or indirect communication between the flexible datacenter **500** and the traditional datacenter **902**. The type of communication link **916** may depend on the locations of the flexible datacenter **500** and the traditional datacenter **902**. Within embodiments, different types of communication links can be used, including but not limited to WAN connectivity, cloud-based connectivity, and wired and wireless communication links.

The queue system **312** represents an abstract data type capable of organizing computational operation requests received from entities. As each request for computational operations are received, the queue system **312** may organize the request in some manner for subsequent distribution to a datacenter. Different types of queues can make up the queue system **312** within embodiments. The queue system **312** may be a centralized queue that organizes all requests for computational operations. As a centralized queue, all incoming requests for computational operations may be organized by the centralized queue.

In other examples, the queue system **312** may be distributed consisting of multiple queue sub-systems. In the distributed configuration, the queue system **312** may use multiple queue sub-systems to organize different sets of computational operations. Each queue sub-system may be used to organize computational operations based on various factors, such as according to deadlines for completing each set of computational operations, locations of enterprises submitting the computational operations, economic value associated with the completion of computational operations, and quantity of computing resources required for performing each set of computational operations. For instance, a first queue sub-system may organize sets of non-intensive computational operations and a second queue sub-system may organize sets of intensive computational operations. In some examples, the queue system **312** may include queue sub-systems located at each datacenter. This way, each datacenter (e.g., via a datacenter control system) may organize computational operations obtained at the datacenter until computing systems are able to start executing the computational operations. In some examples, the queue system **312** may move computational operations between different computing systems or different datacenters in real-time.

Within the arrangement of FIG. **9**, the queue system **312** is shown connected to the remote master control system **300** via the communication link **918**. In addition, the queue system **312** is also shown connected to the flexible datacenter via the communication **920**A and to the traditional datacenter **902** via the communication link **920**B. The communication links **918**, **920**A, **920**B may be similar to the communication link **916** and can be various types of communication links within examples.

The queue system **312** may include a computing system configured to organize and maintain queues within the queue system **312**. In another example, one or more other components of the system may maintain and support queues within the queue system **312**. For instance, the remote master control system **300** may maintain and support the queue system **312**. In other examples, multiple components may maintain and support the queue system **312** in a distributed manner, such as a blockchain configuration.

In some embodiments, the remote master control system **300** may serve as an intermediary that facilitates all communication between flexible datacenter **500** and the traditional datacenter **902**. Particularly, the traditional datacenter **902** or the flexible datacenter **500** might need to transmit communications to the remote master control system **300** in order to communicate with the other datacenter. As also shown, the remote master control system **300** may connect to the queue system **312** via the communication link **918**. Computational operations may be distributed between the queue system **312** and the remote master control system **300** via the communication link **918**. The computational operations may be transferred in real-time and mid-performance from one datacenter to another (e.g., from the traditional datacenter **902** to the flexible datacenter **500**). In addition, the remote master control system **300** may manage the queue system **312**, including providing resources to support queues within the queue system **312**.

As a result, the remote master control system **300** may offload some or all of the computational operations assigned to the traditional datacenter **902** to the flexible datacenter **500**. This way, the flexible datacenter **500** can reduce overall computational costs by using the behind-the-meter power to provide computational resources to assist traditional datacenter **902**. The remote master control system **300** may use the queue system **312** to temporarily store and organize the offloaded computational operations until a flexible datacenter (e.g., the flexible datacenter **500**) is available to perform them. The flexible datacenter **500** consumes behind-the-meter power without transmission or distribution costs, which lowers the costs associated with performing computational operations originally assigned to the traditional datacenter **902**. The remote master control system **300** may further communicate with the flexible datacenter **500** via communication link **922** and the traditional datacenter **902** via the communication link **924**.

FIG. **10**A shows method **1000** of dynamic power consumption at a flexible datacenter using behind-the-meter power according to one or more example embodiments. Other example methods may be used to manipulate the power delivery to one or more flexible datacenters.

In step **1010**, the datacenter control system, the remote master control system, or another computing system may monitor behind-the-meter power availability. In some embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1020**, the datacenter control system or the remote master control system **300** may determine when a datacenter ramp-up condition is met. In some embodiments, the datacenter ramp-up condition may be met when there is sufficient behind-the-meter power availability and there is no operational directive from the generation station to go offline or reduce power.

In step **1030**, the datacenter control system may enable behind-the-meter power delivery to one or more computing systems. In some instances, the remote mater control system may directly enable BTM power delivery to computing systems within the flexible system without instructing the datacenter control system.

In step **1040**, once ramped-up, the datacenter control system or the remote master control system may direct one or more computing systems to perform predetermined computational operations. In some embodiments, the predetermined computational operations may include the execution of one or more distributed computing processes, parallel processes, and/or hashing functions, among other types of processes.

While operational, the datacenter control system, the remote master control system, or another computing system may receive an operational directive to modulate power consumption. In some embodiments, the operational directive may be a directive to reduce power consumption. In such embodiments, the datacenter control system or the remote master control system may dynamically reduce power delivery to one or more computing systems or dynamically reduce power consumption of one or more computing systems. In other embodiments, the operational directive may be a directive to provide a power factor correction factor. In such embodiments, the datacenter control system or the remote master control system may dynamically adjust power delivery to one or more computing systems to achieve a desired power factor correction factor. In still other embodiments, the operational directive may be a directive to go offline or power down. In such embodiments, the datacenter control system may disable power delivery to one or more computing systems.

FIG. **10**B shows method **1050** of dynamic power delivery to a flexible datacenter using behind-the-meter power according to one or more embodiments. In step **1060**, the datacenter control system or the remote master control system may monitor behind-the-meter power availability. In

certain embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1070**, the datacenter control system or the remote master control system may determine when a datacenter ramp-down condition is met. In certain embodiments, the datacenter ramp-down condition may be met when there is insufficient behind-the-meter power availability or anticipated to be insufficient behind-the-meter power availability or there is an operational directive from the generation station to go offline or reduce power.

In step **1080**, the datacenter control system may disable behind-the-meter power delivery to one or more computing systems. In step **1090**, once ramped-down, the datacenter control system remains powered and in communication with the remote master control system so that it may dynamically power the flexible datacenter when conditions change.

One of ordinary skill in the art will recognize that a datacenter control system may dynamically modulate power delivery to one or more computing systems of a flexible datacenter based on behind-the-meter power availability or an operational directive. The flexible datacenter may transition between a fully powered down state (while the datacenter control system remains powered), a fully powered up state, and various intermediate states in between. In addition, flexible datacenter may have a blackout state, where all power consumption, including that of the datacenter control system is halted. However, once the flexible datacenter enters the blackout state, it will have to be manually rebooted to restore power to datacenter control system. Generation station conditions or operational directives may cause flexible datacenter to ramp-up, reduce power consumption, change power factor, or ramp-down.

FIG. **11** illustrates a block diagram of a system for implementing control strategies based on a power option agreement, according to one or more embodiments. The system **1100** represents an example arrangement that includes a control system (e.g., the remote master control system **262**), a load (e.g., one or more of the datacenters **1102**, **1104**, and **1106**), and a power entity **1140**, which may establish and operate in accordance with a power option agreement. Additional arrangements are possible within examples.

In general, a power option agreement is an agreement between a power entity **1140** associated with the delivery of power to a load (e.g., a grid operator, power generation station, or local control station) and the load (e.g., the datacenters **1102-1106**). As part of the power option agreement, the load (e.g., load operator, contracting agent for the load, semi-automated control system associated with the load, and/or automated control system associated with the load) provides the power entity **1140** with the right, but not obligation, to reduce the amount of power delivered (e.g., grid power) to the load up to an agreed amount of power during an agreed upon time interval. In order to provide the power entity **1140** with this option, the load needs to be using at least the amount of power subject to the option (e.g., a minimum power threshold). For instance, the load may agree to use at least 1 MW of grid power at all times during a specified 24-hour time interval to provide the power entity **1140** with the option of being able to reduce the amount of power delivered to the load by any amount up to 1 MW at any point during the specified 24-hour time interval. The load may grant the power entity **1140** with this option in exchange for a monetary consideration (e.g., receive power at a reduced price and/or monetary payment if the option is exercised by the power entity).

The power option agreement may be used by the power entity **1140** to reserve the right to reduce the amount of grid power delivered to the load during a set time frame (e.g., the next 24 hours). For instance, the power entity **1140** may exercise a predefined power option to reduce the amount of grid power delivered to the load during a time when the grid power may be better redirected to other loads coupled to the power grid. As such, the power entity **1140** may exercise power option agreements to balance loads coupled to the power grid. In some embodiments, a power option agreement may also specify other parameters, such as costs associated with different levels of power consumption and/or maximum power thresholds for the load to operate according to.

To illustrate an example, a power option agreement may specify that a load (e.g., the datacenters **1102-1106**) is required to use at least 10 MW or more at all times during the next 12 hours. Thus, the minimum power threshold according to the power option agreement is 10 MW and this minimum power threshold extends across the time interval of the next 12 hours. In order to comply with the agreement, the load must subsequently operate using 10 MW or more power at all times during the next 12 hours. This way, the load can accommodate a situation where the power entity **1140** exercises the option. Particularly, exercising the option may trigger the load to reduce the amount of power it consumes by an amount up to 10 MW at any point during the 12 hour interval. By establishing this power option agreement, the power entity **1140** can manipulate the amount of power consumed at the load during the next 12 hours by up to 10 MW if power needs to be redirected to another load or a reduction in power consumption is needed for other reasons.

In the example arrangement of the system **1100** shown in FIG. **11**, one or more of the datacenters (e.g., the flexible datacenters **1102**, **1104**, and the traditional datacenter **1106**) may operate as the load that is subject to a power option agreement. As the load that is subject to the power option agreement, the datacenters **1102-1106** may execute control instructions in accordance with power target consumption targets that meet or exceed the minimum power thresholds based on the power option agreement.

As shown in FIG. **11**, each datacenter **1102-1106** may include a set of computing systems configured to perform computational operations using power from one or more power sources (e.g., BTM power, grid power, and/or grid power subject to a power option agreement). In particular, the flexible datacenter **1102** includes computing systems **1108** arranged into a first set **1114**A, a second set **1114**B, and a third set **1114**C, the flexible datacenter **1104** includes computing systems **1110** arranged into a first set **1116**A, a second set **1116**B, and a third set **1118**B, and the traditional datacenter **1106** includes computing systems **1112** arranged into a first set **1118**A, a second set **1118**B, and a third set **1118**C. Each set of computing systems may include various types of computing systems that can operate in one or more modes.

The different sets of computing systems as well as the multiple datacenters are included in FIG. **11** for illustration purposes. In particular, the variety of computing systems represent different configurations that a load may take while operating in accordance with a power option agreement, and each configuration (as detailed herein) may include ramping up or down power consumption and transferring and performing computational operations between sets of comput-

ing systems and/or datacenters. In other examples, the load that is subject to a power option agreement may take on other configurations (e.g., a single datacenter **1102-1106**, and/or a single set of computing systems).

The remote master control system **262** may serve as a control system that can determine performance strategies and provide control instructions to the load (e.g., one or more of the datacenters **1102-1106**). In particular, the remote master control system **262** can monitor conditions in concert with the minimum power thresholds and time intervals (e.g., power option data) set forth in, and/or derived from, one or more power option agreements to determine performance strategies that can enable the load to meet the expectations of the power option agreement(s) while also efficiently using power to accomplish computational operations. In some instances, the remote master control system **262** may also be subject to the power option agreement and may adjust its own power consumption based on the power option agreement (e.g., ramp up or down power consumption based on the defined minimum power thresholds during time intervals).

To establish a power option agreement, the remote master control system **262** (or another computing system) may communicate with the power entity **1140**. For instance, the remote master control system **262** may provide a request (e.g., a signal and/or a bid) to the power entity **1140** and receive the terms of one or more power option agreements, or power option data related to power option agreements (e.g., data such as minimum power thresholds and time intervals, but not all terms contained within a potential power option agreement) in response. In some examples, the remote master control system **262** may evaluate one or more conditions prior to establishing a power option agreement to ensure that the conditions could enable the load (e.g., the datacenters **1102-1106**) to operate in accordance with the power option agreement. For instance, the remote master control system **262** may check the quantity and deadlines associated with computational operations assigned to specific datacenters prior to establishing specific datacenters as a load subject to a power option agreement. In some cases, multiple power option agreements may be established. For example, each datacenter **1102-1106** may be subject to a different power option agreement, which may result in the remote master control system **262** managing the power consumption at each of the datacenters **1102-1106** differently.

Within the system **1100** shown in FIG. **11**, the power entity **1140** may represent any type of power entity associated with the delivery of power to the load that is subject to a power option agreement. For instance, the power entity **1140** may be a local station control system, a grid operator, or a power generation source. As such, the power entity **1140** may establish power option agreements with the loads via communication with the loads and/or the remote master control system **262**. For example, the power entity **1140** may obtain and accept a bid from a load trying to engage in a power option agreement with the power entity **1140**. The power entity **1140** is shown with a power option module **1142**, which may be used to establish power option agreements (e.g., fixed-duration 1144 and/or dynamic **1146**).

Once a power option agreement is established, the remote master control system **262** may obtain power option data from the power entity **1140** (or another source) that specifies the power and time expectations of the power entity **1140**. As shown in FIG. **11**, the power entity **1140** includes a power option module **1142**, which may be used to provide power option data to the remote master control system **262** and/or the datacenters **1102-1106**. In particular, the power option data may specify the minimum power threshold or thresholds associated with one or more time intervals for the load to operate at in accordance with based on the power option agreement. The power option data may also specify other constraints that the load should operate in accordance with.

In some examples, the power option data may also include an indication of a monetary penalty that would be imposed upon the load for failure to operate as agreed upon for the power option agreement. In addition, the power option data may also include an indication of a monetary benefit provided to the load operating at power consumption levels that are in accordance with a power option agreement. For instance, monetary benefits could include reduced prices for power, credits for power, and/or monetary payments. In addition, the power option data may include further constraints upon power use, such as one or more maximum power thresholds and corresponding time intervals for the maximum power thresholds.

In some embodiments, the power entity **1140** may correspond to a qualified scheduling entity (QSE). A QSE may submit bids and offers on behalf of resource entities (REs) or load serving entities (LSEs), such as retail electric providers (REPs). QSEs may submit offers to sell and/or bids to buy power (energy) in the Day-Ahead Market (e.g., the next 24 hours) and the Real-Time Market. As such, the remote master control system **262** or another computing system may communicate with one or more QSEs to engage and control one or more loads in accordance with one or more power option agreements.

In some examples, a power option agreement may take the form of a fixed duration power option agreement **1144**. The fixed duration power option agreement **1144** may specify a set of minimum power thresholds and a set of time intervals in advance for an upcoming fixed duration of time covered by the agreement. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. Examples of such association are provided in FIG. **12**. The fixed duration power option agreement may be established in advanced of the time period covered by the set of time intervals to enable the remote master control system **262** to prepare performance strategies for the load (e.g., the datacenter(s)) associated with the power option agreement. Thus, the remote master control system **262** may evaluate the fixed duration power option and other monitored conditions to determine performance strategies for a set of computing systems (e.g., one or more datacenters) during the different intervals that satisfy the minimum power thresholds.

In other examples, a power option agreement may take the form of a dynamic power option agreement **1146**. For a dynamic power option agreement **1146**, minimum power thresholds may be provided to the remote master control system **262** in real-time (or near real-time). For instance, a dynamic power option agreement may specify that the power entity **1140** may provide adjustments to minimum power thresholds and corresponding time intervals in real-time to the remote master control system **262**. For example, a dynamic power option agreement may provide power option data that specifies a minimum power threshold for immediate adjustments (e.g., for the next hour).

In an embodiment, a dynamic power option agreement **1146** may involve repeat communication between the remote master control system **262** and the power entity **1140**. Particularly, the power entity **1140** may provide signals to the remote master control system **262** that request power consumption adjustments to be initiated at one or more

datacenters by the remote master control system **262** over short time intervals, such as across minutes or seconds. For example, the power entity **1140** may communicate to the remote master control system **262** to ramp power consumption down to a particular level within the next 5 minutes. As a result, the remote master control system **262** may provide instructions to one or more datacenters to ramp down power consumption using a linear ramp over the next 5 minutes to meet the particular level specified by the power entity **1140**. The remote master control system **262** may monitor the linear ramp down of power consumption and increase or decrease the rate that the datacenter(s) ramp down power use based on projections and updates received from the power entity **1140**. As a result, although the ramp down of power consumption may initially be performed in a linear manner to meet a power target threshold, the remote master control system **262** may adjust the rate of power consumption decrease based on updates from the power entity **1140**. For example, 25 percent of the overall power consumption ramp down may occur during a first period (e.g., 4 minutes 30 seconds) of the 5 minutes and the remaining 75 percent of the overall power consumption ramp down may occur during the remaining period of the 5 minutes (e.g., the final 30 seconds). The example percentages are included for illustration purposes and can vary within examples based on various parameters, such as additional communication (e.g., adjustments) provided by the power entity **1140**.

In further examples, a power option agreement may operate similarly to both a fixed-duration 1144 and a dynamic power option agreement **1146**. Particularly, power option data specifying minimum power thresholds and corresponding time intervals may be provided in advance for the entire fixed-duration of time (e.g., the next 24 hours). Additional power option data may then be subsequently provided enabling the remote master control system **262** to make one or more adjustments to accommodate any changes specified within the additional power option data. For instance, additional power option data may indicate that a power entity exercised its option to deliver less power to the load. As a result, the remote master control system may instruct the load to adjust power consumption based on the power entity reducing the power threshold minimum via exercising the option.

As indicated above, the remote master control system **262** may monitor conditions in addition to the constraints set forth in power option data received from the power entity **1140**. Particularly, the remote master control system **262** may monitor and analyze a set of conditions (including the power option data) to determine strategies for assigning, transferring, and otherwise managing computational operations using the one or more datacenters **1102-1106**. The determined strategies may enable efficient operation by the datacenters while also ensuring that the datacenters operate at target power consumption levels that meet or exceed the minimum power thresholds set forth within one or more power option agreements.

Example monitored conditions include, but are not limited to, power availability **1120**, power prices **1122**, computing systems parameters **1124**, cryptocurrency prices **1126**, computational operation parameters **1128**, and weather conditions **1129**. Power availability **1120** may include determining power consumption ranges at a set of computing systems and/or at one or more datacenters. In addition, power availability **1120** may also involve determining the source or sources of power available at a datacenter. For instance, the remote master control system **262** may identify the types of power sources (e.g., BTM, grid power, and/or a battery system) that a datacenter has available. Power prices **1122** may involve an analysis of the different costs associated with powering a set of computing systems. For instance, the remote master control system **262** may determine cost of power from the grid without a power option agreement relative to the cost power from the grid under the power option agreement. In addition, the remote master control system **262** may also compare the cost of grid power relative to the cost of BTM power when available at a datacenter. The power prices **1122** may also involve comparing the cost of using power at different datacenters to determine which datacenter may perform computational operations at a lower cost.

Monitoring computing system parameters **1124** may involve determining parameters related to the computing systems at one or more datacenters. For instance, the remote master control system **262** may monitor various parameters of the computing systems at a datacenter, such as the abilities and availability of various computing systems, the status of the queue used to store computational operations awaiting performance by the computing systems. The remote master control system **262** may determine types and operation modes of the computing systems, including which computing systems could operate in different modes (e.g., a higher power or a lower power mode) and/or at different hash rates and/or frequencies. The remote master control system **262** may also estimate when computing systems may complete current computational operations and/or how many computational operations are assigned to computing systems.

Monitoring cryptocurrency prices **1126** may involve monitoring the current price of one or more cryptocurrencies, the hash rate and/or estimated power consumption associated with mining each cryptocurrency, and other factors associated with the cryptocurrencies. The remote master control system **262** may use data related to monitoring cryptocurrency prices **1126** to determine whether using computing systems to mine a cryptocurrency generates more revenue than the cost of power required for performance of the mining operations.

The remote master control system **262** may monitor parameters related to computational operations (e.g., computational operation parameters **1128**). For example, the remote master control system **262** may monitor parameters related to the computational operations requiring performance and currently being performed, such quantity of operations, estimated time to complete, cost to perform each computational operation, deadlines and priorities associated with each computational operation. In addition, the remote master control system **262** may analyze computational operations to determine if a particular type of computing system may perform the computational operation better than other types of computing systems.

Monitoring weather conditions **1129** may include monitoring for any potential power generation disruption due to emergencies or other events, and changes in temperatures or weather conditions at power generators or datacenters that could affect power generation. As such, the operations and environment analysis module (or another component) of the remote master control system **262** may be configured to monitor one or more conditions described above.

The performance strategy determined by the remote master control system **262** based on the monitored conditions and/or power option data can include control instructions for the load (e.g., the datacenters and/or one or more sets of computing systems). For instance, a performance strategy can specify operating parameters, such as operating frequen-

cies, power consumption targets, operating modes, power on/off and/or standby states, and other operation aspects for computing systems at a datacenter.

The performance strategy can also involve aspects related to the assignment, transfer, and performance of computational operations at the computing systems. For instance, the performance strategy may specify computational operations to be performed at the computing systems, an order for completing computational operations based on priorities associated with the computational operations, and an identification of which computing systems should perform which computational operations. In some instances, priorities may depend on revenue associated with completing each computational operation and deadlines for each computational operation.

The monitored conditions may enable efficient distribution and performance of computational operations among computing systems at one or more datacenters (e.g., datacenters **1102-1106**) in ways that can reduce costs and/or time to perform computational operations, take advantage of availability and abilities of computing systems at the datacenters **1102-1106**, and/or take advantage in changes in the cost for power at the datacenters **1102-1106**. In addition, the monitored conditions may also involve consideration of the power option data to ensure that the computing systems consume enough power to meet minimum power thresholds set forth in one or more power option agreements.

The various monitored conditions described above as well as other potential conditions may change dynamically and with great frequency. Thus, to enable efficient distribution and performance of the computational operations at the datacenters, the remote master control system **262** may be configured to monitor changes in the various conditions to assist with the efficient management and operations of the computing systems at each datacenter. For instance, the remote master control system **262** may engage in wired or wireless communication **1130** with datacenter control systems (e.g., datacenter control system **504**) at each datacenter as well as other sources (e.g., the power entity **1140**) to monitor for changes in the conditions.

The remote master control system **262** may analyze the different conditions in real-time to modulate operating attributes of computing systems at one or more of the datacenters. By using the monitored conditions, the remote master control system **262** may increase revenue, decrease costs, and/or increase performance of computational operations via various modifications, such as transferring computational operations between datacenters or sets of computing systems within a datacenter and adjusting performance at one or more sets of computing systems (e.g., switching to a low power mode).

In some examples, the traditional datacenter **1106** may be the load subject to a power option agreement. As such, the remote master control system **262** may factor the power option agreement when determining whether to perform computational operations using the computing systems **1112** at the traditional datacenter **1106** and/or transfer computational operations to the computing systems **1108**, **1110** at the flexible datacenters **1102**, **1104**. For instance, the monitored conditions may indicate that the price of grid power is substantially higher than BTM power. As a result, the remote master control system **262** may transfer a subset of computational operations from the traditional datacenter **1106** to the flexible datacenters **1102**, **1104**. The traditional datacenter **1106** may still have some computational operations to perform to ensure that the traditional datacenter **1106** is using enough power to meet the minimum power threshold or thresholds set forth in the power option agreement.

In some examples, the remote master control system **262** may monitor the grid frequency signal received from the power entity **1140**. When the frequency of the grid deviates a threshold amount (e.g., 0.036 Hz above or below 60 Hz), the remote master control system **262** may adjust performance strategies at the load. In some cases, the remote master control system **262** may adjust the power consumption at the load, the number of miners (or computing systems) operating at the load, and/or the frequency or hash rate, among other possible changes. The remote master control system may readjust performance strategies at the load in response to receiving additional power option data from the power entity **1140** (e.g., an indication that the frequency of the grid is back to 60 Hz). In addition, the remote master control system **262** may communicate changes in operations at the load to the power entity **1140**. This way, the power entity **1140** may obtain confirmation that the load is adjusting in accordance with a power option agreement.

In some embodiments, a power generation source (e.g., the generation station **400** shown in FIG. **4**) may enter into a power option agreement with a grid operator, which may provide the grid operator with the option to reduce the amount of power that the power source generator can deliver to the grid during a defined time interval. For instance, a wind generation farm may enter into the power option agreement with the grid operator. In addition, the remote master control system **262** may also enter into a power option agreement with the power generation source (e.g., the wind farm) to provide a load that can receive excess power from the power generation source when the grid operator exercises the option and lowers the amount of power that the power generation source can deliver to the grid. Thus, rather than reducing the amount of power produced, the power generation source could exercise an option in the agreement with remote master control system **262** and redirect excess power to one or more loads (e.g., a set of computing systems) that could ramp up power consumption in response. In such situations, the remote master control system **262** maybe able to use the excess power from the power generation source (e.g., BTM power) to perform operations at one or more loads at a low cost (or no cost at all). In addition, the power generation source may benefit from the power option agreement by directing excess power to the load instead of temporarily halting power production.

In some examples, a power option agreement may depend on parameters associated balancing grid capacity and demand. For instance, power option agreements may incentivize power consumption ramping during periods of peak grid power use.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments. The graph **1200** shows power option data arranged according to power **1204** over time **1202**. As shown in FIG. **12**, time **1202** increases along the X-axis and minimum power thresholds **1204** increase along the Y-axis of the graph **1200**. In the example embodiment shown in FIG. **12**, the time **1202** increases up to a full day (e.g., 24 hours) in 4 hour increments and the power is shown in MW increasing in intervals of 5 MW. The 24 duration and example minimum power thresholds can differ in other embodiments. Particularly, these values may depend on the terms set forth within the power option agreement.

The graph line **1206** represents sets of minimum power thresholds **1206**A, **1206**B, **1206**C that are specified by

power option data based on the power option agreement. As shown, the graph line **1206** extends the entire 24 hour duration, which indicates that the set of time intervals associated with minimum power thresholds add up to 24 hours. In other examples, the power option agreement may not include a minimum power threshold during a portion of the duration.

The graph line **1206** of the graph **1200** is further used to illustrate power consumption levels that one or more loads (e.g., a set of computing systems) operating according to the power option agreement may utilize during the 24 hour duration. Particularly, the power quantities above the graph line **1206** represents power levels that the load(s) may consume from the power grid during the 24 hour duration that would satisfy the requirements (i.e., the minimum power thresholds **1206**A-**1206**C) set forth by the power option agreement. In particular, the power quantities above the graph line **1206** include any power quantity that meets or exceeds the minimum power threshold at that time. By extension, the power quantities positioned below the graph line **1206** represents the amount of power that the load could be directed to reduce power consumption by per the power option agreement.

To further illustrate, an initial minimum power threshold **1206**A is shown associated with the time interval starting at hour 0 and extending to hour 8. In particular, the minimum power threshold **1206**A is set at 5 MW during this time interval. Thus, based on the power option data shown in FIG. **12**, the loads must be able to operate at a target power consumption level that is equal to or greater than the 5 MW minimum power threshold **1206**A at all times during the time interval extending from hour 0 to hour 8, in order to be able to satisfy the power option if it is exercised for that time interval. Similarly, the power entity could reduce the power consumed by loads by any amount up to 5 MW at any point during the time interval from hour 0 to hour 8 in accordance with the power option agreement. For instance, the power entity could exercise its option at any point during this time interval to reduce the power consumed by the loads by 3 MW as a way to load balance the power grid. In response to the power entity exercising its option, the load may then operate using 3 MW less power and/or another strategy determined by a control system factoring additional conditions (e.g., the price of grid power, the revenue that could be generated from mining a cryptocurrency, and/or parameters associated with computational operations awaiting performance)

As further shown in the graph **1200** illustrated in FIG. **12**, the next minimum power threshold **1206**B is associated with the following time interval, which starts at hour 8 and extends until hour 16. During this time interval (hour 8 to hour 16), the load(s) may consume 10 MW or more power since the minimum power threshold **1206**B is now set at 10 MW as shown on the Y-axis of the graph **1200**. In light of the power option data, a control system may determine and provide a performance strategy to the load (e.g., a set of computing systems) that includes a power consumption target that meets or exceeds the minimum power threshold **1206**B (i.e., 10 MW). The performance strategy may depend on the power option data as well as other possible conditions, such as the price of grid power, the availability of computing systems, and/or the type of computing operations, etc. In addition, the power entity could exercise its option to reduce the amount of power consumed by the load by 10 MW or less as represented by the power levels under the minimum threshold **1206**B that extend during the time interval of hour 8 to hour 16.

The last minimum power threshold **1206**C is associated with the time interval that starts at hour 16 and extends until hour 24. Similar to the initial minimum power threshold **1206**A associated with the beginning of the graph line **1206**, the last minimum power threshold **1206** is also set at 5 MW. As such, at any point during this interval (hour 16 to hour 24) the loads may consume 5 MW or more to operate in accordance with the power option agreement. As discussed above, by operating at 5 MW or more, the load enables the power consumed from the power grid to be reduced any amount from zero up to 5 MW during this time interval.

When determining the power consumption strategy for a load, a computing system (e.g., the remote master control system **262**) may consider various conditions in addition to the power option data received based on one or more power option agreements. Particularly, the computing system may consider and weigh different conditions in addition to the power option data to determine power consumption targets and/or other control instructions for a load. The conditions may include, but are not limited to, the price of grid power, the price of alternative power sources (e.g., BTM power, stored energy), the revenue associated with mining for one or more cryptocurrencies, parameters related to the computational operations requiring performance (e.g., priorities, deadlines, status of the queue organizing the operations, and/or revenue associated with completing each computational operation), parameters related to the set of computing systems (e.g., types and availabilities of computing systems), and other conditions (e.g., penalties if a minimum power threshold is not met and/or monetary benefits from operating under a power option agreement). By weighing various conditions, the computing system may efficiently manage the set of computing systems, including enabling performance of computational operations cost effectively and/or ensuring at that computing systems operate at target power consumption levels that one or more satisfy power option agreements.

In some examples, the computing system may decrease the amount of power that a set of computing systems consumes from one source and while also increasing the amount of power that the set consumes from another source. For instance, the computing system may determine that the price of power grid power is above a threshold price that makes computational operations relatively expensive to perform using grid power. As a result, the computing system may provide control instructions for the computing systems to consume power grid power that matches a minimum power threshold specified by power option data. This may enable the computing systems to satisfy the power option agreement while also avoiding using pricey grid power beyond the minimum amount required per the power option data. In addition, the computing system may instruct some computing systems to switch to a low power mode or temporarily stop until the price of power from the grid decreases. The computing system may instruct one or more computing systems to operate using power from another source (e.g., BTM power and/or stored energy from a battery system) and/or transfer one or more computational operations to another set of computing systems (e.g., a different datacenter).

When the power option agreement is a fixed duration power option agreement, the computing system may receive an indication of all the minimum power thresholds **1206**A-**1206**C and an indication of the associated time interval altogether and in advance of the duration associated with the power option agreement. By providing all of the minimum power thresholds **1206**A-**1206**C and the time intervals in

advance, the computing system may determine a performance strategy for the load that can extend across the entire duration. Particularly, the computing system may factor the minimum power thresholds and associated time intervals as well as other monitored conditions to determine the performance strategy for the total duration. This can enable the computing system to accept and assign computational operations to computing systems in advance while also using a performance strategy that meets the expectations of a power option agreement.

In some examples, the performance strategy determined by the computing system may include control instructions for the set of computing systems to execute if a power option is exercised. For instance, the performance strategy may specify different power consumption targets for the computing systems that depend on whether a power option is exercised during each time interval.

In some instances, the computing system may modify the performance strategy when one or more conditions change enough to warrant a modification. For instance, the computing system may receive an indication of a change in a minimum power threshold (e.g., a decrease in the minimum power threshold) and determine one or more modifications based on the new minimum power threshold and/or other conditions (e.g., a change in the price of power).

In other examples, the power option agreement may be a dynamic power option agreement. Particularly, the load may be subject to a changing minimum power threshold that can vary during a predefined duration associated with the power option agreement. For example, a dynamic power option agreement may specify that the load is subject to a minimum power threshold that may vary from 0 MW up to 5 MW during the next 24 hours and the particular minimum threshold for each hour may depend on power option data received from the power entity during the prior hour. The dynamic power option agreement may further specify the expected response time from the load. For instance, the power option agreement may indicate that an indication of a new minimum power threshold will be provided an hour prior to the start of the minimum power threshold. The computing system, for example, may receive an indication at hour 7 about the increase in the minimum power threshold **1206**B starting at hour 8. The indication may (or may not) specify the total time interval associated with a new minimum power threshold. For instance, the indication received by the computing system may specify that the 10 MW minimum power threshold **1206**B extends from hour 8 until hour 16. In other instances, the power option data may indicate that the computing system should abide by the new minimum power threshold until receiving further power option data indicating a change to another new minimum power threshold.

In some examples, the power option data may arrive at the computing system in an unknown order from the power entity with expectations of swift power consumption adjustments by the load. As a result, the power option agreement may require fast ramping of the load to meet changes. Ramping may involve ramping up or down power consumption as well as ramping operating techniques (e.g., adjusting frequency or operation mode).

In some embodiments, the type of power option power agreement may depend on the delivery and content of power option data provided to the load (or a control system controlling the load). For instance, a computing system may receive minimum power thresholds set across an entire duration associated with a power option agreement in advance when the power option agreement is a fixed-duration power option agreement. In other instances, the computing system may receive power option data dynamically and adjust operations in real-time (or near real-time). For instance, the computing system may receive a series of power option data that each specifies minimum power threshold changes during the duration set forth in the dynamic power option agreement. To illustrate an example, the computing system may receive power option data during hour 1 that specifies the minimum power threshold for hour 2, power option data during hour 2 that specifies the minimum power threshold for hour 3, and so on across the duration of the dynamic power option agreement.

In some examples, the minimum power threshold for a time interval may be zero during the duration of a power option agreement. As such, the load may use any amount of power from the power grid in accordance with the power option agreement, including no power at all during this time interval. When the price for power is high during this time frame, the load may ramp down power usage to zero MW to avoid paying the high price for power while still being in compliance with the power option agreement.

FIG. **13** illustrates a method for implementing control strategies based on a fixed-duration power option agreement, according to one or more embodiments. The method **1300** serves as an example and may include other steps within other embodiments. A control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1300**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At step **1302**, the method **1300** involves monitoring a set of conditions. For instance, a computing system (e.g., a control system) may monitor various conditions that could impact the performance of operations at one or more loads, including the power consumption targets at the loads. The set of monitored conditions may include a variety of information obtained from one or more external sources, such as one or more datacenters, databases, power generation stations, or types of sources.

Some example conditions include, but are not limited to, the price of grid power, the price and availability of alternative power options (e.g. BTM power, and/or stored energy), parameters of the load (e.g., ramping abilities, type of computing systems, operation modes, etc.), parameters of tasks to be performed using the power at the load (e.g., types, deadlines, priorities, and/or revenue associated with computational operations), availability of other computing systems and their associated costs, and/or revenue associated with mining a cryptocurrency. The computing system may monitor one or more of these conditions as well as others.

At step **1304**, the method **1300** involves receiving power option data based, at least in part, on a power option agreement. As discussed above, the computing system (e.g., a remote master control system) may engage in a power option agreement with a power entity. As a result, the computing system may control a load (e.g., a set of computing systems) in accordance with power thresholds and time intervals received from the power entity based on the power option agreement.

In some examples, the power option data may specify a set of minimum power thresholds and a set of time intervals. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. To illustrate an example, the power option data may specify a first minimum power threshold

associated with a first time interval and a second minimum power threshold associated with a second time interval, with the second time interval subsequent to the first time interval.

The set of time intervals may add up to the duration represented by the power option agreement. For instance, the total duration of the set of time intervals may correspond to a twenty-four hour period (e.g., the next day). In other examples, the power option agreement may span across a different duration (e.g., 12 hours). In additional embodiments, the power option data may specify other information, such as monetary incentives associated with parameters of the power option agreement and/or one or more maximum power thresholds.

At step **1306**, the method **1300** involves determining a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy may be determined responsive to receiving the power option data. In addition, the performance strategy may include a power consumption target for the set of computing systems for each time interval in the set of time intervals. In some examples, each power consumption target is equal to or greater than the minimum power threshold associated with each time interval.

As an example, the performance strategy may specify a first power consumption target for the set of computing systems for a first time interval such that the first power consumption target is equal to or greater than a first minimum power threshold associated with the first time interval and a second power consumption target for the set for a second time interval in a similar manner (i.e., the second power consumption target is equal to or greater than a second minimum power threshold).

In some examples, the performance strategy may include an sequence for the set of computing systems to follow when performing computational operations. The sequence, for example, may be based on priorities associated with the computational operations. In addition, the performance strategy may include one or more power consumption targets that are greater than the minimum power thresholds when the price of power from the power grid is below a threshold price during the time intervals associated with the minimum power thresholds.

The performance strategy may also involve transferring, delaying, or adjusting one or more computational operations performed at the set of computing systems. In addition, the performance strategy may involve adjusting operations at the computing systems. For instance, one or more computing systems may switch modes (e.g., operate at a higher frequency or switch to a low power mode).

In addition, the performance strategy may also specify power consumption targets for the set of computing systems to use if the power option is exercised during an interval. This way, the computing systems may continue to perform computational operations (or suspend performance) based on the power option being exercised.

At step **1308**, the method **1300** involves providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy. For example, the set of computing systems may operate according to the performance strategy to ensure that the minimum power thresholds are met during the defined time intervals based on the power option agreement.

Some examples may further involve receiving subsequent power option data based, at least in part, on the power option agreement. The subsequent power option data may specify to decrease one or more minimum power thresholds of the set of power thresholds. Responsive to receiving the subsequent power option data, the performance strategy for the set of computing systems may be modified based on a combination of at least a portion of the subsequent power option data and one or more conditions of the monitored conditions. The modified performance strategy may include one or more reduced power consumption targets for the set of computing systems. The amount of the reduction in a power consumption target may depend linearly with the amount that the corresponding minimum power threshold was reduced by. For instance, when a minimum power threshold for a time interval is reduced from 10 MW to 5 MW, the power consumption target for that time interval may be reduced from 10 MW to 5 MW. Instructions may be provided to the set of computing systems to perform computational operations based on the modified performance strategy.

FIG. **14** illustrates a method for implementing control strategies based on a dynamic power option agreement, according to one or more embodiments. The method **1400** serves as an example and may include other steps within other embodiments. Similar to the method **1400**, a control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1400**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At block **1402**, the method **1400** involves monitoring a set of conditions. Similar to block **1302** of the method **1300**, a computing system may monitor various conditions to determine instructions for controlling a set of computing systems.

At block **1404**, the method **1400** involves receiving first power option data based, at least in part, on a power option agreement while monitoring the set of conditions. The first power option data may specify a first minimum power threshold associated with a first time interval. For example, the first power option data may specify a minimum power threshold of 10 MW for the next hour, which may start in an hour or less.

The power option agreement may correspond to a dynamic power option agreement in some examples. When managing a load with respect to a dynamic power option agreement, a computing system may receive power option data specifying changes in minimum power thresholds that a load (e.g., the set of computing systems) may be designated to use in the near term (e.g., the next hour). For example, the computing system may receive power option data during each hour of the duration specified by a power option agreement that indicates a minimum power threshold for the next hour.

At block **1406**, the method **1400** involves providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition. The first control instructions may be provided responsive to receiving the first power option data.

The first control instructions may include a first power consumption target for the set of computing systems for the first time interval. Particularly, the first power consumption target may be equal to or greater than the first minimum power threshold associated with the first time interval. For example, the first power consumption target may be greater than the first minimum power threshold when a cost of power from the power grid is below a threshold price during the first time interval. In other instances, the first power consumption target may be equal to the first minimum power

threshold when the cost of power from the power grid is greater than the threshold price.

In some examples, control instructions may specify a sequence for the computing systems to follow when performing computational operations. The sequence may be based on priorities associated with each computational operation.

The first control instructions may be determined based on a combination of the first power option data, the price of power from the power grid, and parameters associated with computational operations to be performed at the set of computing systems.

In some examples, the first control instructions may involve ramping up or down power consumption at the set of computing systems. The power consumption may be ramped up or down based on the first minimum power threshold and one or more other conditions (e.g., the price of power).

At block **1408**, the method **1400** involves receiving second power option data based, at least in part, on the power option agreement while monitoring the set of conditions. The computing system may receive the second power option data subsequent to receiving the first power option data. The second power option data may specify a second minimum power threshold associated with a second time interval. For example, the second minimum power threshold may be 7 MW over the duration of the upcoming hour. In other examples, the second minimum power threshold may differ as shown in FIG. **12**.

In some instances, the computing system may receive the second power option data during the first time interval such that the second time interval overlaps the first time interval. For instance, the computing system may receive the second power option data to enable real-time adjustments to be made to the power consumed at the set of computing systems.

At block **1410**, the method **1400** involves providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power option data and at least one condition. The second control instructions may be provided responsive to receiving the second power option data. The second control instructions may specify a second power consumption target for the set of computing systems for the second time interval. The second power consumption target may be equal to or greater than the second minimum power threshold associated with the second time interval.

In some examples, the computing system may provide a request to a QSE to determine the power option agreement. As such, the computing system may receive power option data (e.g., the first and second power option data) in response to providing the request to the QSE.

The computing system may monitor the price of power from the power grid, and the global mining hash rate and a price for a cryptocurrency (e.g., Bitcoin), among other conditions. The computing system may determine control instructions (e.g., the first and/or second control instructions) based on a combination of power option data, the price of power from the power grid, and the global mining hash rate and the price for the cryptocurrency. For instance, the computing system may cause one or more computing systems (e.g., a subset of computing systems) to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Advantages of one or more embodiments of the present invention may include one or more of the following:

One or more embodiments of the present invention provides a green solution to two prominent problems: the exponential increase in power required for growing blockchain operations and the unutilized and typically wasted energy generated from renewable energy sources.

One or more embodiments of the present invention allows for the rapid deployment of mobile datacenters to local stations. The mobile datacenters may be deployed on site, near the source of power generation, and receive low cost or unutilized power behind-the-meter when it is available.

One or more embodiments of the present invention provide the use of a queue system to organize computational operations and enable efficient distribution of the computational operations across multiple datacenters.

One or more embodiments of the present invention enable datacenters to access and obtain computational operations organized by a queue system.

One or more embodiments of the present invention allows for the power delivery to the datacenter to be modulated based on conditions or an operational directive received from the local station or the grid operator.

One or more embodiments of the present invention may dynamically adjust power consumption by ramping-up, ramping-down, or adjusting the power consumption of one or more computing systems within the flexible datacenter.

One or more embodiments of the present invention may be powered by behind-the-meter power that is free from transmission and distribution costs. As such, the flexible datacenter may perform computational operations, such as distributed computing processes, with little to no energy cost.

One or more embodiments of the present invention provides a number of benefits to the hosting local station. The local station may use the flexible datacenter to adjust a load, provide a power factor correction, to offload power, or operate in a manner that invokes a production tax credit and/or generates incremental revenue.

One or more embodiments of the present invention allows for continued shunting of behind-the-meter power into a storage solution when a flexible datacenter cannot fully utilize excess generated behind-the-meter power.

One or more embodiments of the present invention allows for continued use of stored behind-the-meter power when a flexible datacenter can be operational but there is not an excess of generated behind-the-meter power.

One or more embodiments of the present invention allows for management and distribution of computational operations at computing systems across a fleet of datacenters such that the performance of the computational operations take advantages of increased efficiency and decreased costs.

It will also be recognized by the skilled worker that, in addition to improved efficiencies in controlling power delivery from intermittent generation sources, such as wind farms and solar panel arrays, to regulated power grids, the invention provides more economically efficient control and stability of such power grids in the implementation of the technical features as set forth herein.

While the present invention has been described with respect to the above-noted embodiments, those skilled in the art, having the benefit of this disclosure, will recognize that other embodiments may be devised that are within the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the appended claims.

What is claimed is:

1. A system comprising:

a set of computing systems, wherein the set of computing systems is configured to perform computational operations using power from a power grid;

a control system configured to:

monitor a set of conditions;

receive power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

2. The system of claim 1, wherein the control system is configured to monitor the set of conditions comprising:

a price of power from the power grid; and

a plurality of parameters associated with one or more computational operations to be performed at the set of computing systems.

3. The system of claim 2, wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at least the portion option data, the price of power from the power grid, and the plurality of parameters associated with the one or more computational operations.

4. The system of claim 3, wherein the performance strategy further comprises:

an order for the set of computing systems to follow when performing the one or more computational operations, wherein the order is based on respective priorities associated with the one or more computational operations.

5. The system of claim 4, wherein the performance strategy further comprises:

at least one power consumption target that is greater than a minimum power threshold when the price of power from the power grid is below a threshold price during the time interval associated with the minimum power threshold.

6. The system of claim 1, wherein the control system is further configured to:

receive subsequent power option data based, at least in part, on the power option agreement,

wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

7. The system of claim 6, wherein the control system is further configured to:

responsive to receiving the subsequent power option data, modify the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions,

wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems.

8. The system of claim 7, wherein the control system is further configured to:

provide instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

9. The system of claim 1, wherein the control system is a remote master control system positioned remotely from the set of computing systems.

10. The system of claim 1, wherein the control system is a mobile computing device.

11. The system of claim 1, wherein the control system is configured to receive the power option data while monitoring the set of conditions.

12. The system of claim 1, wherein the control system is further configured to:

provide a request to a qualified scheduling entity (QSE) to determine the power option agreement; and

receive power option data in response to providing the request to the QSE.

13. The system of claim 1, wherein the power option data specify: (i) a first minimum power threshold associated with a first time interval in the set of time intervals, and (ii) a second minimum power threshold associated with a second time interval in the set of time intervals,

wherein the second time interval is subsequent to the first time interval.

14. The system of claim 13, wherein the control system is configured to:

determine the performance strategy for the set of computing systems such that the performance strategy comprises:

a first power consumption target for the set of computing systems for the first time interval, wherein the first power consumption target is equal to or greater than the first minimum power threshold; and

a second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

15. The system of claim 1, wherein a total duration of the set of time intervals corresponds to a twenty-four hour period.

16. The system of claim 1, wherein the set of conditions monitored by the control system further comprise:

a price of power from the power grid; and

a global mining hash rate and a price for a cryptocurrency; and

wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at the portion of the power option data, the price of power from the power grid, the global mining hash rate and the price for the cryptocurrency,

wherein the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

17. A method comprising:

monitoring, by a computing system, a set of conditions;

receiving, at the computing system, power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

18. The method of claim **17**, wherein determining the performance strategy for the set of computing systems comprises:

identifying information about the set of computing systems; and

determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems.

19. The method of claim **17**, further comprising:

receiving subsequent power option data based, at least in part, on the power option agreement, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds;

responsive to receiving the subsequent power option data, modifying the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions, wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems; and

providing instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

20. A non-transitory computer readable medium having stored therein instructions executable by one or more processors to cause a computing system to perform functions comprising:

monitoring a set of conditions;

receiving power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

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CLOSED,APPEAL,CASREF,DISCOVERY-CJB,MOTREF,PATENT

U.S. District Court
District of Delaware (Wilmington)
CIVIL DOCKET FOR CASE #: 1:21-cv-00534-GBW-CJB

BearBox LLC et al v. Lancium LLC et al	Date Filed: 04/14/2021
Assigned to: Judge Gregory B. Williams	Date Terminated: 04/05/2023
Referred to: Judge Christopher J. Burke	Jury Demand: Plaintiff
Case in other court: 23-01922	Nature of Suit: 830 Patent
Cause: 35:271 Patent Infringement	Jurisdiction: Federal Question

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Date Filed	#	Docket Text
04/14/2021	1	COMPLAINT filed with Jury Demand against Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara - Magistrate Consent Notice to Pltf. (Filing fee $ 402, receipt number ADEDC-3592779.) - filed by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Civil Cover Sheet)(sam) (Entered: 04/14/2021)
04/14/2021	2	Notice, Consent and Referral forms re: U.S. Magistrate Judge jurisdiction. (sam) (Entered: 04/14/2021)
04/14/2021	3	Report to the Commissioner of Patents and Trademarks for Patent/Trademark Number 10,608,433. (sam) (Entered: 04/14/2021)
04/14/2021	4	Summonses Issued (please complete the top portion of the form and print out for use/service). (sam) (Entered: 04/14/2021)
04/14/2021	5	PRAECIPE filed by Andrew Colin Mayo on behalf of BearBox LLC, Austin Storms requesting Clerk to issue *certified papers for service* (Mayo, Andrew) (Entered: 04/14/2021)
04/14/2021	6	Disclosure Statement pursuant to Rule 7.1: No Parents or Affiliates Listed filed by BearBox LLC. (Mayo, Andrew) (Entered: 04/14/2021)
04/14/2021	7	SUMMONS Returned Executed by BearBox LLC, Austin Storms. Lancium LLC served on 4/14/2021, answer due 5/5/2021. (Mayo, Andrew) (Entered: 04/14/2021)
04/14/2021	8	SUMMONS Returned Executed by BearBox LLC, Austin Storms. Michael T. McNamara served on 4/14/2021, answer due 5/5/2021. (Mayo, Andrew) (Entered: 04/14/2021)
04/14/2021	9	SUMMONS Returned Executed by BearBox LLC, Austin Storms. Raymond E. Cline, Jr served on 4/14/2021, answer due 5/5/2021. (Mayo, Andrew) (Entered: 04/14/2021)
04/15/2021	10	Postal Receipt(s) for the mailing of process to Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (kmd) (Entered: 04/15/2021)

04/21/2021		Case Assigned to Judge Maryellen Noreika. Please include the initials of the Judge (MN) after the case number on all documents filed. (rjb) (Entered: 04/21/2021)
04/23/2021	11	MOTION for Pro Hac Vice Appearance of Attorney Benjamin T. Horton, John R. Labbe, Raymond R. Ricordati, III, and Chelsea M. Murray - filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 04/23/2021)
04/23/2021		SO ORDERED re 11 MOTION for Pro Hac Vice Appearance of Attorney Benjamin T. Horton, John R. Labbe, Raymond R. Ricordati, III, and Chelsea M. Murray filed by BearBox LLC, Austin Storms. ORDERED by Judge Maryellen Noreika on 4/23/2021. (dlw) (Entered: 04/23/2021)
04/27/2021	12	Return of Service Executed re: D.I. 10 Postal Receipts. (kmd) (Entered: 04/27/2021)
04/28/2021		Pro Hac Vice Attorneys Benjamin T. Horton, Raymond R. Ricordati, III, Chelsea M. Murray for BearBox LLC and Austin Storms added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (kmd) (Entered: 04/28/2021)
04/29/2021		Pro Hac Vice Attorney John R. Labbe for BearBox LLC and Austin Storms added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (mal) (Entered: 04/29/2021)
05/03/2021	13	[SEALED] ANSWER to 1 Complaint, with Jury Demand , COUNTERCLAIM against BearBox LLC, Austin Storms by Michael T. McNamara, Raymond E. Cline, Jr, Lancium LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Certificate of Service)(Stover, Chad) (Entered: 05/03/2021)
05/03/2021	14	MOTION to Seal Document: 13 Answer to Complaint,, Counterclaim, - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A, # 2 Text of Proposed Order)(Stover, Chad) (Entered: 05/03/2021)
05/03/2021	15	Disclosure Statement pursuant to Rule 7.1: identifying Corporate Parent Lancium Technologies Corporation, Other Affiliate SBI Crypto Investment Company Ltd. for Lancium LLC filed by Lancium LLC. (Stover, Chad) (Entered: 05/03/2021)
05/04/2021	16	ORAL ORDER GRANTING 14 Motion to Seal Document - IT IS HEREBY ORDERED that the motion is GRANTED. Defendants' shall file a redacted version within seven (7) days. ORDERED by Judge Maryellen Noreika on 5/4/2021. (dlw) (Entered: 05/04/2021)
05/04/2021	17	MOTION for Pro Hac Vice Appearance of Attorney Mark C. Nelson - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certification by Counsel to be Admitted Pro Hac Vice (Mark C. Nelson))(Stover, Chad) (Entered: 05/04/2021)
05/04/2021		SO ORDERED, re 17 MOTION for Pro Hac Vice Appearance of Attorney Mark C. Nelson filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. ORDERED by Judge Maryellen Noreika on 5/4/2021. (mdb) (Entered: 05/04/2021)
05/06/2021		Pro Hac Vice Attorney Mark C. Nelson for Raymond E. Cline, Jr, Lancium LLC, and Michael T. McNamara added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (mal) (Entered: 05/06/2021)
05/12/2021	18	REDACTED VERSION of 13 Answer to Complaint,, Counterclaim, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Stover, Chad) (Entered: 05/12/2021)

05/24/2021	19	AMENDED COMPLAINT against Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara- filed by Austin Storms, BearBox LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B)(Mayo, Andrew) (Additional attachment(s) added on 5/25/2021: # 3 Redline Comparison) (dlw). (Entered: 05/24/2021)
05/24/2021	20	ANSWER to 13 Answer to Complaint,, Counterclaim, by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 05/24/2021)
05/25/2021	21	ORAL ORDER - IT IS HEREBY ORDERED that the parties shall confer regarding proposed dates in the scheduling order and shall submit a proposed order, including a proposal for the length and timing of trial, to the Court no later than thirty (30) days from the date of this Order. The parties are to use the Court's form scheduling order, which is posted at http://www.ded.uscourts.gov (see Chambers, Judge Noreika, Forms (last updated 4/2021)). If there are disputes or issues that the Court needs to address in the proposed scheduling order, the parties shall direct the Court to the paragraph numbers in which those appear in a cover letter to the Court. ORDERED by Judge Maryellen Noreika on 5/25/2021. (dlw) (Entered: 05/25/2021)
05/27/2021	22	NOTICE OF SERVICE of i) Defendants Lancium LLC, Michael T. McNamara and Raymond E. Cline, Jr.'s First Set of Requests to Produce to Plaintiffs and ii) Defendants Lancium LLC, Michael T. McNamara and Raymond E. Cline, Jr.'s First Set of Interrogatories to Plaintiffs filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 05/27/2021)
06/04/2021	23	[SEALED] ANSWER to Amended Complaint, re: 19 Amended Complaint, with Jury Demand , COUNTERCLAIM against BearBox LLC, Austin Storms by Michael T. McNamara, Raymond E. Cline, Jr, Lancium LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Certificate of Service)(Stover, Chad) (Entered: 06/04/2021)
06/04/2021	24	REDACTED VERSION of 23 Answer to Amended Complaint,, Counterclaim, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Stover, Chad) (Entered: 06/04/2021)
06/09/2021	25	NOTICE OF SERVICE of Plaintiffs' First Set of Interrogatories Directed to all Defendants filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 06/09/2021)
06/23/2021	26	ANSWER to 23 Answer to Amended Complaint,, Counterclaim, by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 06/23/2021)
06/24/2021	27	Letter to The Honorable Maryellen Noreika from Andrew C. Mayo regarding proposed scheduling order. (Attachments: # 1 Proposed Scheduling Order)(Mayo, Andrew) (Entered: 06/24/2021)
06/25/2021	28	[SEALED] AMENDED ANSWER to 19 Amended Complaint,, COUNTERCLAIM against BearBox LLC, Austin Storms by Michael T. McNamara, Raymond E. Cline, Jr, Lancium LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Certificate of Service)(Stover, Chad) (Additional attachment(s) added on 6/28/2021: # 6 Redline Comparison) (dlw). (Entered: 06/25/2021)
06/25/2021	29	NOTICE OF SERVICE of Defendants' Responses to Plaintiffs' Requests for Production of Documents and Things (Nos. 1-30) filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 06/25/2021)
06/25/2021	30	REDACTED VERSION of 28 Amended Answer to Complaint,, Counterclaim, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Stover, Chad) (Entered: 06/25/2021)

06/25/2021	31	NOTICE OF SERVICE of Plaintiffs' Objections and Responses to Defendants' First Set of Requests for Production of Documents (Nos. 1-11 and Plaintiffs' Objections and Responses to Defendants' First Set of Interrogatories (Nos. 1-9) filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 06/25/2021)
06/28/2021	32	MOTION for Judgment on the Pleadings - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order)(Stover, Chad) (Entered: 06/28/2021)
06/28/2021	33	OPENING BRIEF in Support re 32 MOTION for Judgment on the Pleadings filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.Answering Brief/Response due date per Local Rules is 7/12/2021. (Stover, Chad) (Main Document 33 replaced on 6/29/2021) (dlw). (Entered: 06/28/2021)
06/29/2021		CORRECTING ENTRY: D.I. 33 has been replaced on the docket at the request of counsel. The track changes have now all been accepted. (dlw) (Entered: 06/29/2021)
07/01/2021	34	STIPULATION TO EXTEND TIME for Plaintiffs to respond to Defendants' Motion for Judgment on the Pleadings to July 19, 2021 - filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 07/01/2021)
07/01/2021		SO ORDERED re 34 STIPULATION TO EXTEND TIME for Plaintiffs to respond to Defendants' Motion for Judgment on the Pleadings to July 19, 2021 (Set Briefing Schedule: re 32 MOTION for Judgment on the Pleadings - Answering Brief due 7/19/2021). ORDERED by Judge Maryellen Noreika on 7/1/2021. (dlw) (Entered: 07/01/2021)
07/06/2021	35	SCHEDULING ORDER: Case referred to the Magistrate Judge for the purpose of exploring ADR. Joinder of Parties due by 11/1/2021. Amended Pleadings due by 11/1/2021. Fact Discovery completed by 12/14/2021. Opening Expert Reports due by 1/18/2022. Rebuttal Expert Reports due by 2/18/2022. Reply Expert Reports due by 3/5/2022. Expert Discovery due by 4/13/2022. Dispositive Motions due by 6/13/2022. A Pretrial Conference is set for 11/22/2022 at 04:30 PM in Courtroom 4A before Judge Maryellen Noreika. A 4-day Jury Trial is set for 12/5/2022 at 09:30 AM in Courtroom 4A before Judge Maryellen Noreika. Signed by Judge Maryellen Noreika on 7/6/2021. (dlw) (Entered: 07/06/2021)
07/07/2021		CASE REFERRED to Magistrate Judge Mary Pat Thynge for Mediation. Please see Standing Order dated January 20, 2016, regarding disclosure of confidential ADR communications. A link to the standing order is provided here for your convenience at https://www.ded.uscourts.gov/sites/ded/files/forms/StandingOrderforADR-Mediation.pdf (Taylor, Daniel) (Entered: 07/07/2021)
07/07/2021		ORAL ORDER: This matter has been referred to Chief Magistrate Judge Mary Pat Thynge for ADR. Should any party (or all parties) desire to discuss mediation and its timing, the party(ies) shall contact Judge Thynge and her Law Clerk, Daniel Taylor (daniel_taylor@ded.uscourts.gov), to request that a teleconference be scheduled. Ordered by Judge Mary Pat Thynge on 7/7/2021. (Taylor, Daniel) (Entered: 07/07/2021)
07/08/2021	36	MOTION for Pro Hac Vice Appearance of Attorney Adam M. Kaufmann - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certification by Counsel to be Admitted Pro Hac Vice)(Stover, Chad) (Entered: 07/08/2021)
07/08/2021		SO ORDERED re 36 MOTION for Pro Hac Vice Appearance of Attorney Adam M. Kaufmann filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. ORDERED by Judge Maryellen Noreika on 7/8/2021. (dlw) (Entered: 07/08/2021)

07/09/2021	37	STIPULATION TO EXTEND TIME for Plaintiffs to respond to Defendants' Counterclaims to July 16, 2021 - filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 07/09/2021)
07/09/2021		SO ORDERED re 37 STIPULATION TO EXTEND TIME for Plaintiffs to respond to Defendants' Counterclaims to July 16, 2021. ORDERED by Judge Maryellen Noreika on 7/9/2021. (dlw) (Entered: 07/09/2021)
07/12/2021	38	NOTICE OF SERVICE of Plaintiffs' Initial Disclosures and Plaintiffs' Disclosures pursuant to Section 3 of the Court's Default Standard for Discovery filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 07/12/2021)
07/12/2021	39	NOTICE OF SERVICE of (i) Defendants' Initial Disclosures and (ii) Defendants' Disclosures Pursuant to Paragraph 3 of the Courts Default Standard for Discovery filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 07/12/2021)
07/16/2021	40	STIPULATION TO EXTEND TIME for the submission of a proposed protective order to July 23, 2021 - filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 07/16/2021)
07/16/2021		SO ORDERED, re 40 STIPULATION TO EXTEND TIME for the submission of a proposed protective order to July 23, 2021 filed by BearBox LLC, Austin Storms. Ordered by Judge Maryellen Noreika on 7/16/2021. (asw) (Entered: 07/16/2021)
07/16/2021	41	ANSWER to 28 Amended Answer to Complaint,, Counterclaim, by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 07/16/2021)
07/19/2021	42	ANSWERING BRIEF in Opposition re 32 MOTION for Judgment on the Pleadings filed by BearBox LLC, Austin Storms.Reply Brief due date per Local Rules is 7/26/2021. (Mayo, Andrew) (Entered: 07/19/2021)
07/22/2021	43	STIPULATION TO EXTEND TIME for Defendants to file a reply in support of their Motion for Judgment on the Pleadings to July 30, 2021 - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 07/22/2021)
07/22/2021		SO ORDERED re 43 STIPULATION TO EXTEND TIME for Defendants to file a reply in support of their Motion for Judgment on the Pleadings to July 30, 2021 (Set Briefing Schedule: re 32 MOTION for Judgment on the Pleadings - Reply Brief due 7/30/2021). ORDERED by Judge Maryellen Noreika on 7/22/2021. (dlw) (Entered: 07/22/2021)
07/23/2021		Pro Hac Vice Attorney Adam Kaufmann for Raymond E. Cline, Jr,Lancium LLC,and Michael T. McNamara added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (apk) (Entered: 07/23/2021)
07/23/2021	44	NOTICE PF SERVICE of Defendants' Responses to Plaintiffs' First Set of Interrogatories Directed to All Defendants by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara (Stover, Chad) Modified on 7/23/2021 (dlw). (Entered: 07/23/2021)
07/28/2021	45	ORAL ORDER Setting Teleconference: Having been advised by the parties of their inability to resolve a protective order dispute, IT IS HEREBY ORDERED that a Telephone Conference is set for 9/8/2021 at 11:00 AM before Judge Maryellen Noreika. The joint 2-page letter attaching the protective order with the competing provisions included is due on or before 9/2/2021. Counsel shall provide a teleconference dial-in number and code for the teleconference by emailing this Court's judicial administrator. ORDERED by Judge Maryellen Noreika on 7/28/2021. (dlw) (Entered: 07/28/2021)

07/30/2021	46	REPLY to Response to Motion re 32 MOTION for Judgment on the Pleadings filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 07/30/2021)
08/05/2021	47	REQUEST for Oral Argument by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara re 32 MOTION for Judgment on the Pleadings . (Stover, Chad) (Entered: 08/05/2021)
08/23/2021	48	Joint Letter to The Honorable Maryellen Noreika from Andrew C. Mayo regarding disputed provision in protective order. (Attachments: # 1 Text of Proposed Order)(Mayo, Andrew) (Entered: 08/23/2021)
08/24/2021	49	ORAL ORDER - IT IS HEREBY ORDERED that the current discovery dispute and all future FACT discovery disputes are referred to Judge Christopher J. Burke. Judge Burke will issue a further order regarding the logistics for the 9/8/2021 11:00 AM teleconference, including whether it will be held as scheduled or rescheduled. ORDERED by Judge Maryellen Noreika on 8/24/2021. (dlw) (Entered: 08/24/2021)
08/24/2021	50	ORAL ORDER: The Court, having been referred all fact discovery disputes in this case, hereby ORDERS as follows: (1) The currently-pending protective order discovery dispute will go forward on the same date and time as was previously scheduled by Judge Noreika.; (2) The parties should file a "Motion to Resolve Discovery Disputes" for the Court's administrative purposes. Some suggested text for this motion can be found in the Forms tab of Magistrate Judge Burke's page on the District Court's website.; (3) Additionally, by no later than September 2, 2021, the parties shall jointly provide the Court's Courtroom Deputy, Ms. Benyo, with a dial-in number via e-mail to use for the call.; and (4) It is possible that the Court may choose to resolve this dispute prior to the telephone conference and may, in that event, cancel the conference. Ordered by Judge Christopher J. Burke on 8/24/2021. (dlb) (Entered: 08/24/2021)
08/25/2021	51	Joint MOTION for Teleconference to Resolve Protective Order Dispute - filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 08/25/2021)
08/25/2021		MOTION REFERRED: 51 Joint MOTION for Teleconference to Resolve Protective Order Dispute Motion referred to Christopher J. Burke.(dlb) (Entered: 08/25/2021)
08/25/2021	52	ORAL ORDER: The Court, having reviewed the case history in light of the August 24, 2021 referral, hereby ORDERS that going forward, the procedures for resolving a dispute relating to fact discovery shall be as follows: Should counsel find, after good faith efforts including verbal communication among Delaware and Lead Counsel for all parties to the dispute, that they are unable to resolve a discovery matter, the parties involved in the dispute shall submit a joint letter with the text set out in the Court's standard Rule 16 Scheduling Order for Patent Cases, which can be found in the "Forms" tab of Magistrate Judge Burke's page on the District Court's website. The moving party (i.e., the party seeking relief from the Court) should also file a Motion For Teleconference To Resolve Discovery Dispute. The suggested text for this motion can be found in the same Forms tab. The Court will thereafter set a discovery dispute telephone conference and letter briefing schedule. Ordered by Judge Christopher J. Burke on 8/25/2021. (dlb) (Entered: 08/25/2021)
08/27/2021	53	NOTICE OF SERVICE of Plaintiffs' Supplemental Objections and Responses to Defendants' First Set of Interrogatories (Nos. 1-9) filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 08/27/2021)
08/31/2021	54	Letter to The Honorable Maryellen Noreika from Andrew C. Mayo regarding joint status report in connection with request for claim construction hearing. (Mayo, Andrew) (Entered: 08/31/2021)

08/31/2021	55	MOTION for Pro Hac Vice Appearance of Attorney Dana Amato Sarros - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certification by Counsel to be Admitted Pro Hac Vice)(Stover, Chad) (Entered: 08/31/2021)
09/01/2021		SO ORDERED re 55 MOTION for Pro Hac Vice Appearance of Attorney Dana Amato Sarros filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. ORDERED by Judge Maryellen Noreika on 9/1/2021. (dlw) (Entered: 09/01/2021)
09/01/2021		Pro Hac Vice Attorney Dana A. Sarros for Raymond E. Cline, Jr, Lancium LLC, and Michael T. McNamara added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (twk) (Entered: 09/01/2021)
09/08/2021		Minute Entry for proceedings held before Judge Christopher J. Burke - Discovery Conference held on 9/8/2021. The Court heard argument from the parties regarding the protective order dispute, (D.I. 51). The Court ordered that Defendants' proposed provision be inserted into the parties' protective order, and further ordered the parties to submit a proposed protective order within three business days. The transcript of the teleconference shall serve as the substance of the Court's order. (Court Reporter Stacy Ingram (Hawkins). Clerk: M. Crawford) Appearances: A. Mayo, J. Labbe, B. Horton for Plaintiff; C. Stover, A. Kaufmann for Defendants. (mlc) (Entered: 09/08/2021)
09/10/2021	56	PROPOSED ORDER (Proposed Protective Order) by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 09/10/2021)
09/10/2021	57	ORAL ORDER REFERRING CASE to Magistrate Judge Christopher J. Burke - IT IS HEREBY ORDERED that this case, including the pending motion to dismiss, is referred to Magistrate Judge Christopher J. Burke to hear and resolve all pre-trial matters up to and including expert discovery matters (but not including summary judgment motions, Daubert motions, pre-trial motions in limine or the pre-trial conference), subject to 28 U.S.C. § 636(b) and any further Order of the Court. All subsequent filings in this action shall be captioned as follows: Civil Action No. 21-534-MN-CJB. Signed by Judge Maryellen Noreika on 9/10/2021. (dlw) (Entered: 09/10/2021)
09/10/2021	58	PROTECTIVE ORDER. Signed by Judge Christopher J. Burke on 9/10/2021. (dlb) (Entered: 09/10/2021)
09/13/2021		REMARK: The parties should be aware that the Court encourages the participation of newer attorneys in courtroom proceedings and at oral argument. Please see the Court's Standing Order Regarding Courtroom Opportunities for Newer Attorneys, a link to which is provided here for the parties' convenience:http://www.ded.uscourts.gov/sites/ded/files/forms/StandingOrder2017.pdf (dlb) (Entered: 09/13/2021)
09/13/2021	59	ORAL ORDER: The Court, having reviewed the parties' August 31, 2021 letter regarding the need for a claim construction hearing, (D.I. 54), in light of the September 10, 2021 referral of the case, (D.I. 57), hereby ORDERS that Plaintiffs' request to extend the deadline for the parties to notify the Court whether or not claim construction is necessary in this case to October 15, 2021 is GRANTED. Ordered by Judge Christopher J. Burke on 9/13/2021. (dlb) (Entered: 09/13/2021)
10/11/2021	60	NOTICE OF SERVICE of Defendants' First Supplemental Responses to Plaintiffs' First Set of Interrogatories (Nos. 1-4) Directed to All Defendants filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 10/11/2021)
10/15/2021	61	Letter to The Honorable Christopher J. Burke from Andrew C. Mayo regarding request

		for claim construction hearing. (Mayo, Andrew) (Entered: 10/15/2021)
10/15/2021	62	[SEALED] NOTICE of Service of Subpoenas by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Certificate of Service)(Stover, Chad) (Main Document 62 replaced on 10/15/2021) (mdb). (Entered: 10/15/2021)
10/15/2021		CORRECTING ENTRY: The main document of the Notice of Service (62) has been replaced to add "CONFIDENTIAL - FILED UNDER SEAL" in the caption. (mdb) (Entered: 10/15/2021)
10/15/2021	63	Letter to Judge Christopher J. Burke from Chad S.C. Stover regarding Claim Construction. (Stover, Chad) (Entered: 10/15/2021)
10/18/2021	64	NOTICE OF SERVICE of Notice of Subpoenas filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 10/18/2021)
10/21/2021	65	NOTICE OF SERVICE of (i) Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline Jr.'s Second Set of Interrogatories to Plaintiffs (Nos. 10-18) and (ii) Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline Jr.'s Second Set of Requests for Production to Plaintiffs and (iii) Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline Jr.'s First Requests for Admissions to Plaintiffs (Nos. 1-33) filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 10/21/2021)
10/25/2021	66	AFFIDAVIT of Service for Subpoena to Produce Documents, Information, Or Objects or to Permit Inspection of Premises in a Civil Action and Schedule A served on GIidePath Power Solutions, LLC c/o Corporation Service Company on 10/15/2021, filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 10/25/2021)
10/25/2021	67	AFFIDAVIT of Service for Subpoena to Produce Documents, Information or Objects or to Permit Inspection of Premises in a Civil Action and Subpoena A served on Pareto Real Estate Advisors, LLC on 10/18/2021, filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 10/25/2021)
10/25/2021	68	AFFIDAVIT of Service for Subpoena to Produce Documents, Information, Or Objects or to Permit Inspection of Premises in a Civil Action and Schedule A served on Benjamin H. Hakes on 10/19/2021, filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 10/25/2021)
10/29/2021		CORRECTING ENTRY: DI 69 deleted per request of counsel, filed in incorrect case. (smg) (Entered: 10/29/2021)
10/29/2021	69	[SEALED] NOTICE OF SERVICE of (i) Subpoena to Great American Mining, LLC to appear to testify and (ii) Subpoena Great American Mining, LLC to produce documents filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A - subpoena to appear to testify (Great American Mining, LLC), # 2 Exhibit B - subpoena to produce documents (Great American Mining, LLC), # 3 Certificate of Service)(Stover, Chad) (Entered: 10/29/2021)
10/29/2021	70	REDACTED VERSION of 62 Notice (Other), by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C)(Stover, Chad) (Entered: 10/29/2021)
10/29/2021	71	REDACTED VERSION of 69 Notice of Service, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A, # 2 Exhibit B)(Stover, Chad) (Entered: 10/29/2021)

11/03/2021	72	AFFIDAVIT of Service for Subpoena to Testify at a Deposition served on Great American Mining, Inc. on 11/1/2021, filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 11/03/2021)
11/03/2021	73	AFFIDAVIT of Service for Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises served on Great American Mining, Inc. on 11/1/2021, filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 11/03/2021)
11/04/2021	74	NOTICE OF SERVICE of Subpoena to Produce Documents to Fortress Blockchain (US) Holdings Corp. filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A)(Stover, Chad) (Entered: 11/04/2021)
11/09/2021	75	NOTICE OF SERVICE of Plaintiffs' Supplemental Objections and Responses to Defendants' First Set of Interrogatories (Nos. 1-9) filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 11/09/2021)
11/10/2021	76	AFFIDAVIT of Service for Subpoena to Produce Documents, Information or Objects or to Permit Inspection of Premises served on Fortress Blockchain (US) Holdings Corp. on 11/4/2021, filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 11/10/2021)
11/12/2021	77	NOTICE OF SERVICE of Plaintiffs' Second Set of Requests for Production of Documents and Things to Defendants (Nos. 31-41); (2) Plaintiffs' Second Set of Interrogatories Directed to All Defendants (Nos. 6-16); and (3) Notice of Deposition of Lancium LLC filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 11/12/2021)
11/15/2021	78	NOTICE OF SERVICE of (i) Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline Jr.'s Third Set of Interrogatories to Plaintiffs (Nos. 22-25) (ii) Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline Jr.'s Third Set of Requests to Produce to Plaintiffs and (iii) Defendants Lancium LLC, Michael T. McNamara, and Raymond E. Cline Jr.'s Second Requests for Admissions to Plaintiffs (Nos. 34-41) filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 11/15/2021)
11/18/2021	79	NOTICE to Take Deposition of Bearbox, LLC on December 9, 2021 at 9AM (ET) filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A)(Stover, Chad) (Entered: 11/18/2021)
11/19/2021	80	NOTICE OF SERVICE of Subpoena to Testify at a Deposition to Benjamin H. Hakes filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 11/19/2021)
11/19/2021	81	NOTICE to Take Deposition of Austin Storms on December 10, 2021 filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 11/19/2021)
11/22/2021	82	STIPULATION to amend certain deadlines in scheduling order by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 11/22/2021)
11/22/2021	83	NOTICE OF SERVICE of (i) Plaintiffs' Objections and Responses to Defendants' Second Set of Requests for Production of Documents (Nos. 12-42); (ii) Plaintiffs' Objections and Responses to Defendants' Second Set of Interrogatories (Nos. 10-21); and (iii) Plaintiffs' Objections and Responses to Defendants' First Set of Requests for Admission (Nos. 1-33) filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 11/22/2021)
11/23/2021		SO ORDERED D.I. 82 Stipulation to extend certain scheduling order deadlines filed by BearBox LLC, Austin Storms. Pretrial Conference and Trial deadlines remain unchanged.

		Ordered by Judge Christopher J. Burke on 11/23/2021. (dlb) (Entered: 11/23/2021)
12/02/2021	84	NOTICE OF SERVICE of Defendant Lancium, LLC's Objections to Plaintiffs' Notice of 30(b)(6) Deposition of Lancium, LLC filed by Lancium LLC.(Stover, Chad) (Entered: 12/02/2021)
12/15/2021	85	NOTICE OF SERVICE of Subpoena to Testify at a Deposition to Benjamin H. Hakes filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A)(Stover, Chad) (Entered: 12/15/2021)
12/23/2021	86	NOTICE OF SERVICE of 1) Defendants' Supplemental Response to Plaintiffs' Interrogatory No. 3; 2) Defendants' Responses to Plaintiffs' Second Set of Requests for Production of Documents and Things (Nos. 31-41); and 3) Defendants Responses to Plaintiffs' Second Set of Interrogatories Directed to All Defendants (Nos. 6-16) filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 12/23/2021)
12/23/2021	87	NOTICE OF SERVICE of (i) Plaintiffs' Objections and Responses to Defendants' Third Set of Requests for Production of Documents (Nos. 43-54), (ii) Plaintiffs' Objections and Responses to Defendants' Second Set of Requests for Admission (Nos. 34-41), and (iii) Plaintiffs' Objections and Responses to Defendants' Third Set of Interrogatories (Nos. 22-25) filed by BearBox LLC.(Mayo, Andrew) (Entered: 12/23/2021)
01/04/2022	88	STIPULATION to amend scheduling order by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 01/04/2022)
01/04/2022	89	SO ORDERED D.I. 88 Stipulation to amend Scheduling Order filed by BearBox LLC, Austin Storms. Ordered by Judge Christopher J. Burke on 1/4/2022. (mlc) (Entered: 01/04/2022)
01/10/2022	90	NOTICE OF SERVICE of Defendants Supplemental Initial Disclosures filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 01/10/2022)
01/18/2022	91	PROPOSED ORDER (Proposed Addendum to Protective Order to Address Source Code) by BearBox LLC. (Mayo, Andrew) (Entered: 01/18/2022)
01/18/2022	92	REPORT AND RECOMMENDATIONS re 32 MOTION for Judgment on the Pleadings filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. Please note that when filing Objections pursuant to Federal Rule of Civil Procedure 72(b)(2), briefing consists solely of the Objections (no longer than ten (10) pages) and the Response to the Objections (no longer than ten (10) pages). No further briefing shall be permitted with respect to objections without leave of the Court. Objections to R&R due by 2/1/2022. Signed by Judge Christopher J. Burke on 1/18/2021. (dlb) (Entered: 01/18/2022)
01/19/2022	93	Source Code ADDENDUM to Protective Order. Signed by Judge Christopher J. Burke on 1/18/2021. (dlb) (Entered: 01/19/2022)
01/20/2022	94	NOTICE OF SERVICE of Subpoena to Testify at a Deposition to Benjamin H. Hakes filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A)(Stover, Chad) (Entered: 01/20/2022)
01/27/2022	95	NOTICE OF SERVICE of Plaintiffs' Objections to Defendants' Rule 30(b)(6) Notice of Deposition of BearBox, LLC filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 01/27/2022)
01/31/2022	96	NOTICE OF SERVICE of Subpoena to Testify at a Deposition to Jason Hutzler filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A)(Stover, Chad) (Entered: 01/31/2022)

02/02/2022	97	ORDER ADOPTING 92 REPORT AND RECOMMENDATION GRANTING 32 Motion for Judgment on the Pleadings - IT IS HEREBY ORDERED that the 92 Report and Recommendation is ADOPTED and 32 Defendants' Motion for Judgment on the Pleadings is GRANTED. Counts III and IV of 19 Plaintiffs Amended Complaint are DISMISSED WITHOUT PREJUDICE and Count V is DISMISSED WITH PREJUDICE. Plaintiff is given leave to file a further amended complaint on or before February 16, 2022. Signed by Judge Maryellen Noreika on 2/2/2022. (dlw) (Entered: 02/02/2022)
02/03/2022	98	NOTICE OF SERVICE of Subpoena to Testify at a Deposition to GlidePath Power Solutions LLC filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A)(Stover, Chad) (Entered: 02/03/2022)
02/07/2022	99	NOTICE OF SERVICE of Plaintiffs' Supplemental Objections and Responses to Defendants' Interrogatory Nos. 4 and 11 and Plaintiffs' Supplemental Objections and Responses to Defendants' Requests for Admission Nos. 1 and 2 filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 02/07/2022)
02/08/2022	100	SUBPOENA Returned Executed as to GlidePath Power Solutions, LLC c/o Corporation Service Company on 2/4/2022 (Stover, Chad) (Entered: 02/08/2022)
02/10/2022	101	SUBPOENA Returned Executed as to Jason Hutzler to appear at a deposition on 2/2/2022 (Stover, Chad) (Entered: 02/10/2022)
02/14/2022	102	NOTICE to Take Deposition of Rachel Arndt on February 17, 2022 filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 02/14/2022)
02/16/2022	103	Second AMENDED COMPLAINT against Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara- filed by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit A, # 2 Exhibit B)(Mayo, Andrew) (Additional attachment(s) added on 2/17/2022: # 3 Redline Comparison) (dlw). (Entered: 02/16/2022)
02/16/2022	104	NOTICE to Take Deposition of Michael McNamara on February 18, 2022 filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 02/16/2022)
02/16/2022	105	NOTICE to Take Deposition of Vitor Henrique on February 21, 2022 filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 02/16/2022)
02/18/2022	106	NOTICE OF SERVICE of Amended Subpoena to Testify at a Deposition to Jason Hutzler filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A)(Stover, Chad) (Entered: 02/18/2022)
02/18/2022	107	NOTICE to Take Deposition of Austin Storms on February 23, 2022 at 9AM (CT) filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 02/18/2022)
02/22/2022	108	NOTICE to Take Deposition of Raymond Cline, Jr. on February 24, 2022 filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 02/22/2022)
03/02/2022	109	STIPULATION TO EXTEND TIME re: Current Case Deadlines to - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 03/02/2022)
03/02/2022	110	STIPULATION TO EXTEND TIME to Respond to Second Amended Complaint to March 16, 2022 - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 03/02/2022)
03/03/2022		SO ORDERED D.I. 109 STIPULATION TO EXTEND Current Case Deadlines filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. See Stip for details. (Opening Expert Reports due by 4/5/2022, Rebuttal Expert Reports due by 5/6/2022,

		Expert Discovery due by 6/6/2022, Dispositive Motions due by 6/13/2022.) Ordered by Judge Christopher J. Burke on 3/3/2022. (dlb) (Entered: 03/03/2022)
03/03/2022		SO ORDERED D.I. 110 STIPULATION TO EXTEND TIME to Respond to Second Amended Complaint to March 16, 2022 filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. Ordered by Judge Christopher J. Burke on 3/3/2022. (dlb) (Entered: 03/03/2022)
03/03/2022	111	MOTION to Strike 103 Amended Complaint, *the Trade Secret Misappropriation Counts in the Second Amended Complaint* - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order)Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 03/03/2022)
03/03/2022	112	[SEALED] Letter to The Honorable Christopher J. Burke from Chad S.C. Stover regarding Defendants' Motion to Strike the Trade Secret Misappropriation Counts in the Second Amended Complaint - re 111 MOTION to Strike 103 Amended Complaint, *the Trade Secret Misappropriation Counts in the Second Amended Complaint*. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Certificate of Service)(Stover, Chad) (Entered: 03/03/2022)
03/10/2022	113	[SEALED] Letter to The Honorable Christopher J. Burke from Andrew C. Mayo regarding response to motion to strike. (Attachments: # 1 Exhibit A-J)(Mayo, Andrew) (Entered: 03/10/2022)
03/14/2022	114	[SEALED] Letter to The Honorable Christopher J. Burke from Chad S.C. Stover regarding Defendants' Letter Reply Brief to Motion to Strike the Trade Secret Misappropriation Counts in the Second Amended Complaint - re 112 Letter, 111 MOTION to Strike 103 Amended Complaint, *the Trade Secret Misappropriation Counts in the Second Amended Complaint*. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2 (Declaration of Adam Kaufmann), # 3 Exhibit 3, # 4 Exhibit 4, # 5 Exhibit 5, # 6 Exhibit 6, # 7 Exhibit 7, # 8 Certificate of Service)(Stover, Chad) (Entered: 03/14/2022)
03/14/2022	115	Letter to The Honorable Christopher J. Burke from Chad S.C. Stover regarding Lancium's request for a teleconference on Lancium's Motion to Strike the Trade Secret Misappropriation Counts in the Second Amended Complaint - re 111 MOTION to Strike 103 Amended Complaint, *the Trade Secret Misappropriation Counts in the Second Amended Complaint*. (Stover, Chad) (Entered: 03/14/2022)
03/14/2022	116	Letter to The Honorable Christopher J. Burke from Andrew C. Mayo regarding Request for Discovery Hearing. (Mayo, Andrew) (Entered: 03/14/2022)
03/15/2022	117	REDACTED VERSION of 112 Letter, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit A, # 2 Exhibit B)(Stover, Chad) (Entered: 03/15/2022)
03/15/2022	118	ORAL ORDER Setting Teleconference: The Court has reviewed the parties' March 14, 2022 letters requesting a teleconference regarding Defendants Motion to Strike the Trade Secret Misappropriation Counts in the Second Amended Complaint (the "motion to strike") and regarding one discovery dispute. (D.I. 115; D.I. 116) It hereby ORDERS as follows: (1) A telephone conference to address the motion to strike and the discovery dispute is set for April 4, 2022 at 3:00 PM before Judge Christopher J. Burke.; (2) The parties shall file a joint "Motion for Teleconference to Resolve Discovery Dispute," the text of which can be found in the "Forms" tab of Judge Burke's page on the District Court's website.; (3) By March 22, 2022, any party seeking relief shall file with the Court a letter, not to exceed two (2) single-spaced pages, in no less than 12-point font, outlining the issue in dispute and its position on that issue. By March 29, 2022, any party opposing the application for relief may file a letter, not to exceed two (2) single-spaced pages, in no

		less than 12-point font, outlining that party's reasons for its opposition.; (4) The parties should also consult and follow Judge Burke's "Guidelines for Discovery Disputes," which is found in the "Guidelines" tab on Judge Burke's portion of the District Court's website.; (5) By no later than March 31, 2022, the parties shall jointly provide the Court's Courtroom Deputy, Deborah Benyo, with a dial-in number via e-mail to use for the call.; and (6) The Court may choose to resolve the motion to strike and discovery dispute prior to the telephone conference and will, in that event, cancel the conference. Ordered by Judge Christopher J. Burke on 3/15/2022. (dlb) (Entered: 03/15/2022)
03/16/2022	119	MOTION for Pro Hac Vice Appearance of Attorney Darrick J. Hooker - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certification by Counsel to be Admitted Pro Hac Vice)Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 03/16/2022)
03/16/2022	120	MOTION to Dismiss Based upon // Motion to Dismiss Counts V and VI of the Second Amended Complaint - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order)(Stover, Chad) (Entered: 03/16/2022)
03/16/2022	121	OPENING BRIEF in Support re 120 MOTION to Dismiss Based upon // Motion to Dismiss Counts V and VI of the Second Amended Complaint filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.Answering Brief/Response due date per Local Rules is 3/30/2022. (Stover, Chad) (Entered: 03/16/2022)
03/16/2022		MOTION REFERRED: 120 MOTION to Dismiss Based upon // Motion to Dismiss Counts V and VI of the Second Amended Complaint Motion referred to Christopher J. Burke.(dlb) (Entered: 03/17/2022)
03/17/2022	122	REDACTED VERSION of 113 Letter by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 03/17/2022)
03/21/2022	123	REDACTED VERSION of 114 Letter,, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3, # 4 Exhibit 4, # 5 Exhibit 5, # 6 Exhibit 6, # 7 Exhibit 7)(Stover, Chad) (Entered: 03/21/2022)
03/22/2022	124	[SEALED] Letter to The Honorable Christopher J. Burke from Andrew C. Mayo regarding April 4, 2022 discovery dispute hearing. (Attachments: # 1 Exhibit A-G)(Mayo, Andrew) (Entered: 03/22/2022)
03/28/2022	125	[SEALED] STIPULATION regarding 1-page letter briefs in connection with motion to strike by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit A, # 2 Exhibit B) (Mayo, Andrew) (Entered: 03/28/2022)
03/29/2022		SO ORDERED D.I. 125 Stipulation regarding 1-page letter briefs in connection with motion to strike filed by BearBox LLC, Austin Storms. Ordered by Judge Christopher J. Burke on 3/29/2022. (mlc) (Entered: 03/29/2022)
03/29/2022	126	[SEALED] Letter to The Honorable Christopher J. Burke from Chad S.C. Stover regarding response to Plaintiffs' Motion to Compel - re 124 Letter. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Certificate of Service)(Stover, Chad) (Entered: 03/29/2022)
03/30/2022	127	REDACTED VERSION of 124 Letter by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 03/30/2022)
03/30/2022	128	ANSWERING BRIEF in Opposition re 120 MOTION to Dismiss Based upon // Motion to Dismiss Counts V and VI of the Second Amended Complaint filed by BearBox LLC, Austin Storms.Reply Brief due date per Local Rules is 4/6/2022. (Mayo, Andrew) (Entered: 03/30/2022)

04/01/2022	129	NOTICE OF SERVICE of Plaintiffs' Supplemental Objections and Responses to Defendants' Interrogatory Nos. 22, 24 and 25 filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 04/01/2022)
04/04/2022	130	ORAL ORDER Resetting Hearing on Motion and Discovery Dispute Teleconference: Due to an unforeseen scheduling conflict, the Motion Hearing and Discovery Dispute Teleconference set for April 4, 2022 at 3:00 PM will be rescheduled. It is hereby ORDERED that the Discovery Dispute and Motion Hearing Teleconference is rescheduled for 4/22/2022 at 03:00 PM before Judge Christopher J. Burke. By no later than April 18, 2022, the parties shall jointly provide the Court's Courtroom Deputy, Deborah Benyo, with a dial-in number via e-mail to use for the call. Ordered by Judge Christopher J. Burke on 4/4/2022. (dlb) (Entered: 04/04/2022)
04/04/2022	131	[SEALED] Letter to the Honorable Christopher J. Burke from Chad S.C. Stover regarding re: exhibit inadvertently omitted from Defendants' response to Plaintiffs' Motion to Compel - re 126 Letter. (Attachments: # 1 Exhibit, # 2 Certificate of Service) (Stover, Chad) (Entered: 04/04/2022)
04/04/2022		CASE NO LONGER REFERRED to Chief Magistrate Judge Thynge for the purpose of exploring ADR. Pursuant to the Court's Standing Order No. 2022-2, dated March 14, 2022, "[u]nless otherwise directed by the Court, Magistrate Judges will no longer engage in alternative dispute resolution of patent and securities cases." *See also* 28 U.S.C. § 652(b). (Taylor, Daniel) (Entered: 04/04/2022)
04/05/2022	132	REDACTED VERSION of 126 Letter by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2)(Stover, Chad) (Entered: 04/05/2022)
04/06/2022	133	REPLY BRIEF re 120 MOTION to Dismiss Based upon // Motion to Dismiss Counts V and VI of the Second Amended Complaint filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 04/06/2022)
04/12/2022	134	Joint MOTION for Teleconference to Resolve Discovery Dispute re 130 Order Setting Hearing on Motion,, - filed by BearBox LLC, Austin Storms. Motions referred to Christopher J. Burke.(Mayo, Andrew) (Entered: 04/12/2022)
04/13/2022	135	REQUEST for Oral Argument by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara re 120 MOTION to Dismiss Based upon // Motion to Dismiss Counts V and VI of the Second Amended Complaint, 111 MOTION to Strike 103 Amended Complaint, *the Trade Secret Misappropriation Counts in the Second Amended Complaint*. (Stover, Chad) (Entered: 04/13/2022)
04/14/2022		SO ORDERED D.I. 119 MOTION for Pro Hac Vice Appearance of Attorney Darrick J. Hooker filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. Ordered by Judge Christopher J. Burke on 4/14/2022. (dlb) (Entered: 04/14/2022)
04/14/2022		Pro Hac Vice Attorney Darrick J. Hooker for Raymond E. Cline, Jr, Lancium LLC, and Michael T. McNamara added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (srs) (Entered: 04/14/2022)
04/20/2022	136	ORAL ORDER: The Court, having reviewed the pending motion to dismiss ("Motion"), (D.I. 120), hereby ORDERS as follows: (1) The Court will hear argument on the Motion on Monday, May 23, 2022 at 1:00 PM via teleconference.; (2) By no later than May 18, 2022, the parties shall jointly provide the Court's Courtroom Deputy, Ms. Benyo, with a dial-in number via e-mail to use for the call; and (3) The Court may choose to resolve the Motion prior to the telephone conference and will, in that event, cancel the conference (however, if any party advises the Court in advance that a newer attorney will argue the

		Motion, see Standing Order Regarding Courtroom Opportunities for Newer Attorneys, https://www.ded.uscourts.gov/sites/ded/files/StandingOrder2017.pdf, then the Court will go forward with the conference). Ordered by Judge Christopher J. Burke on 4/20/2022. (dlb) (Entered: 04/20/2022)
04/21/2022	137	ORAL ORDER: The Court, having reviewed Plaintiffs' discovery dispute motion, (D.I. 124; D.I. 134), notes that pursuant to its "Guidelines for Discovery Disputes" (Guideline #2), Plaintiffs were required to "attach a proposed order to [their] letter brief as an exhibit" in which they were to "clearly set out the nature of the requested relief as to each dispute." See Guidelines for Discovery Disputes, https://www.ded.uscourts.gov/sites/ded/files/Guidelines%20for%20Discovery%20Disputes-CJB.pdf. So far as the Court can tell, Plaintiffs did not do that, and their failure to do so is impacting the Court's ability to resolve the dispute. By no later than 5:00 p.m. today, Plaintiffs shall file such a proposed order; failure to do so will result in denial of Plaintiffs' motion. Ordered by Judge Christopher J. Burke on 4/21/2022. (dlb) (Entered: 04/21/2022)
04/21/2022	138	PROPOSED ORDER (Order Granting Lancium's Motion to Compel) re 137 Oral Order,,, by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 04/21/2022)
04/22/2022		Minute Entry for proceedings held before Judge Christopher J. Burke - Telephonic Motion Hearing held on 4/22/2022 regarding D.I. 134 Joint MOTION for Teleconference to Resolve Discovery Dispute; D.I. 111 MOTION to Strike 103 Amended Complaint, *the Trade Secret Misappropriation Counts in the Second Amended Complaint* filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. The Court heard the parties' arguments regarding the motions. The Court granted Plaintiffs' discovery dispute motion. The Court granted Defendants' Motion to Strike. The transcript shall serve as the substance of the Court's Orders. (Court Reporter Christa Chakejian. Clerk: S. Janicki) APPEARANCES: A. Mayo, B. Horton, and J. Labbe for Plaintiffs; C. Stover, M. Nelson, and A. Kaufmann for Defendants. (mlc) (Entered: 04/25/2022)
05/04/2022	139	MOTION for Pro Hac Vice Appearance of Attorney David M. Lisch - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certification by Counsel to be Admitted Pro Hac Vice)Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 05/04/2022)
05/06/2022	140	NOTICE OF SERVICE of 1) Expert Report of Source Code Expert Nikolaus Baer; 2) Expert Report of Mark Ehsani, Ph.D.; and 3) Report of Shams Siddiqi, Ph.D. (Ercot Market Mechanisms) filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 05/06/2022)
05/09/2022	141	NOTICE OF SERVICE of Expert Reports of David R. Duski, Stan McClellan and Frank McCamant filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 05/09/2022)
05/20/2022	142	STIPULATION and [Proposed] Order to Amend Certain Case Deadlines re 124 Letter, SO ORDERED,, Set Scheduling Order Deadlines, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 05/20/2022)
05/23/2022		SO ORDERED D.I. 139 MOTION for Pro Hac Vice Appearance of Attorney David M. Lisch filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. Ordered by Judge Christopher J. Burke on 5/22/2022. (dlb) (Entered: 05/23/2022)
05/23/2022		Minute Entry for proceedings held before Judge Christopher J. Burke - Motion Hearing held on 5/23/2022 via telephone regarding D.I. re 120 MOTION to Dismiss Based upon // Motion to Dismiss Counts V and VI of the Second Amended Complaint filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. The Court heard argument from the parties regarding the motion. The Court took the motion under advisement.

		(Court Reporter Stacy Ingram (Hawkins). Clerk: M. Crawford) Appearances: A. Mayo, B. Horton, J. Labbe for Plaintiffs; C. Stover, A. Kaufmann, M. Nelson for Defendants. (mlc) (Entered: 05/23/2022)
05/24/2022		SO ORDERED D.I. 142 Stipulation to extend certain scheduling order deadlines. Ordered by Judge Christopher J. Burke on 8/24/2022. (dlb) (Entered: 05/24/2022)
05/26/2022	143	REPORT AND RECOMMENDATION: The Court, having reviewed Defendants' motion seeking dismissal, pursuant to Fed. R. Civ. P 12(b)(6), of Plaintiffs' Count V (conversion) and Count VI (unjust enrichment) in the operative Second Amended Complaint ("Motion"), (D.I. 120), the briefing related thereto, (D.I. 121; D.I. 128; D.I. 133), and having heard argument on May 23, 2022, hereby recommends as follows: (1) With regard to Count V, the Court recommends that the Motion be DENIED. Defendants' argument is that Plaintiffs' conversion claim must fail as a matter of law because under Louisiana law (which both sides agree applies to these claims) there can be no conversion of electronic files (the type of documents allegedly converted in Count V) where the owner retains a copy of those files (as Plaintiffs acknowledge it did), since in such a case, the owner is not completely deprived of the property at issue. (D.I. 133 at 2-6) This is a difficult issue, and Defendants do cite to some Louisiana state court precedent that provides some support for their position. See CamSoft Data Sys., Inc. v. S. Elecs. Supply, Inc., 2019 CA 0731, 2019 CW 0514, 2019 WL 2865359, at *2-3 & n. 3 (La. Ct. App. July 2, 2019) (concluding that a claim for conversion could not stand because "a conversion requires a deprivation of possession" and the plaintiff retained a copy of the allegedly converted electronic materials at issue); but see Mabile v. BP, p.l.c., CIVIL ACTION NO. 11-1783, 2016 WL 5231839, at *1, *23 (E.D. La. Sept. 22, 2016) (permitting a conversion claim under Louisiana law that was premised on the defendant's obtaining of the plaintiff's schematic, where the plaintiff e-mailed a digital copy of the schematic but also retained a copy); cf. Total Safety, U.S., Inc. v. Code Red Safety & Rental, LLC, CIVIL ACTION NO. 19-12953, 2019 WL 5964971, at *1, *4-5 (E.D. La. Nov. 13, 2019). But regardless of whether Defendants are correct on that point, Louisiana law says that a conversion claim can be made out not only when a defendant unlawfully interferes with a plaintiff's "possession" of a movable, but also when a defendant unlawfully interferes with the plaintiffs "ownership" of a movable. CamSoft, 2019 WL 2865359, at *2; see also (D.I. 128 at 7-8). It seems to the Court that this leaves some room for a conversion claim as to property (such as the electronic data at issue here), where, even if a plaintiff is not completely dispossessed of all copies of that property, a defendant could still be said to have taken steps to have wrongfully deprived the plaintiff of "ownership" of the property. And Plaintiffs' conversion claim can be read to allege that this is what occurred here, since Plaintiffs assert, inter alia, that Defendants took certain technology that Plaintiffs rightfully owned[,] and then Defendants wrongfully utilized that technology in their Smart Response softwarei.e., in a manner indicating to the world that they (not Plaintiffs) owned that technology. (D.I. 103 at paras. 84-90; see also D.I. 128 at 8); and (2) With regard to Count VI, the Court recommends that the Motion be GRANTED and that the claim be dismissed with prejudice. The Louisiana Supreme Court explicitly held in Walters v. MedSouth Record Mgmt. LLC, 38 So. 3d 243, 244 (La. 2010), that: (a) an element of an unjust enrichment claim under Louisiana law is that there must be no other remedy at law available to the plaintiff, since this type of claim is "only applicable to fill a gap in the law where no express remedy is provided"; (b) if a plaintiff asserts in a pleading that he has another type of legal remedy for the same conduct (the "other remedy"), this establishes that he is precluded from seeking an unjust enrichment remedy for that conducteven if the plaintiff is ultimately unable to pursue that other remedy in the instant proceeding (i.e., because the plaintiffs claim as to that other remedy was dismissed). Recent federal appellate and district court decisions have recognized that this is the state of Louisiana law. See Ferrara Fire Apparatus, Inc. v. JLG Indus., Inc., 581 F. Appx 440, 443-44 (5th Cir. 2014); United States v. Cytogel Pharma, LLC, CIVIL

		DOCKET NO. 16-13987, 2018 WL 5297753, at *16 n.218 (E.D. La. Oct. 25, 2018); Andretti Sports Mktg. La., LLC v. Nola Motorsports Host Comm., CIVIL ACTION NO. 15-2167, 2015 WL 13540096, at *7-8 (E.D. La. Dec. 2, 2015). And what Walters proscribes is what has happened here: i.e., Plaintiffs have pleaded that they had other remedies at law for the conduct that is at issue in their unjust enrichment claim (such as via a claim for trade secret misappropriation, or for conversion). (See, e.g., D.I. 103 at paras. 66-101; see also D.I. 121 at 8-9) Plaintiffs cite to some Louisiana federal district court decisions for the proposition that their unjust enrichment claim can survive under these circumstances. (D.I. 128 at 10 (citations omitted)) But those cases do not persuade the Court, as they either: (a) cite only to Fed. R. Civ. P. 8 for the proposition that a party may plead in the alternative (which, while true, is overtaken here by the fact that as a matter of substantive state law, if one pleads that one does have a legal alternative, then one simply cannot make out an unjust enrichment claim), see JP Mack Indus. LLC v. Mosaic Fertilizer, LLC, 970 F. Supp. 2d 516, 521 n.2 (E.D. La. 2013); or (b) rely on Louisiana state legal precedent that pre-dates Walters; or (c) distinguish Walters (in the Court's view, incorrectly) as only barring unjust enrichment claims from being pleaded alongside tort claims (which, even if it were an accurate reading of Walters, still would not help Plaintiffs here, as they have in fact pleaded alternative tort claims in their operative complaint). Please note that when filing Objections pursuant to Federal Rule of Civil Procedure 72(b)(2), briefing consists solely of the Objections (no longer than ten (10) pages) and the Response to the Objections (no longer than ten (10) pages). No further briefing shall be permitted with respect to objections without leave of the Court. Objections to R&R due by 6/9/2022 Ordered by Judge Christopher J. Burke on 5/26/2022. (dlb) (Entered: 05/26/2022)
05/27/2022	144	NOTICE OF SERVICE of Supplemental Expert Report of David R. Duski filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 05/27/2022)
06/09/2022	145	[SEALED] ANSWER to Amended Complaint, re: 103 Amended Complaint, , COUNTERCLAIM against BearBox LLC, Austin Storms by Raymond E. Cline, Jr, Michael T. McNamara, Lancium LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Certificate of Service)(Stover, Chad) (Entered: 06/09/2022)
06/09/2022	146	OBJECTION to 143 Report and Recommendations by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certification Pursuant to District of Delaware Standing Order for Objections Filed Under Fed. R. Civ. P. 72, # 2 Exhibit 1, # 3 Exhibit 2)(Stover, Chad) (Entered: 06/09/2022)
06/10/2022	147	STIPULATION and [Proposed] Order to Amend Certain Dispositive Motion and Daubert Deadlines re SO ORDERED, Set Scheduling Order Deadlines, SO ORDERED,, Set Scheduling Order Deadlines, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 06/10/2022)
06/10/2022		SO ORDERED D.I. 147 Stipulation to Amend Certain Dispositive Motion and Daubert Deadlines filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. Ordered by Judge Christopher J. Burke on 6/10/2022. (dlb) (Entered: 06/10/2022)
06/15/2022	148	MOTION for Summary Judgment - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order)(Stover, Chad) (Entered: 06/15/2022)
06/15/2022	149	[SEALED] OPENING BRIEF in Support re 148 MOTION for Summary Judgment filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.Answering Brief/Response due date per Local Rules is 6/29/2022. (Attachments: # 1 Certificate of Service)(Stover, Chad) (Entered: 06/15/2022)

06/15/2022	150	[SEALED]CONCISE STATEMENT of Undisputed Material Facts re 148 MOTION for Summary Judgment by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certificate of Service)(Stover, Chad) Modified on 6/16/2022 (dlw). (Entered: 06/15/2022)
06/15/2022	151	[SEALED] DECLARATION OF Adam M. Kaufmann re 150 Statement, 148 MOTION for Summary Judgment by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1-23, # 2 Certificate of Service)(Stover, Chad) Modified on 6/16/2022 (dlw). (Entered: 06/15/2022)
06/15/2022	152	MOTION to Preclude Certain Testimony of Dr. Mark Ehsani - filed by BearBox LLC, Austin Storms. Motions referred to Christopher J. Burke.(Mayo, Andrew) Modified on 6/16/2022 (dlw). (Entered: 06/15/2022)
06/15/2022	153	[SEALED] OPENING BRIEF in Support re 152 MOTION to Preclude Certain Testimony of Dr. Mark Ehsani filed by BearBox LLC, Austin Storms. Answering Brief/Response due date per Local Rules is 6/29/2022. (Mayo, Andrew) Modified on 6/16/2022 (dlw). (Entered: 06/15/2022)
06/15/2022	154	[SEALED] DECLARATION of John R. Labbe re 153 Opening Brief in Support by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit A-B)(Mayo, Andrew) Modified on 6/16/2022 (dlw). (Entered: 06/15/2022)
06/16/2022		Motion No Longer Referred: 152 MOTION to Preclude Certain Testimony of Dr. Mark Ehsani (dlw) (Entered: 06/16/2022)
06/20/2022	155	NOTICE of Change of Address by Chad S.C. Stover (Stover, Chad) (Entered: 06/20/2022)
06/22/2022	156	NOTICE OF SERVICE of Expert Report of Jennifer Vanderhart, Ph.D. and Corrected Expert Report of Jennifer Vanderhart Ph.D. filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 06/22/2022)
06/23/2022	157	NOTICE to Take Deposition of David R. Duski on June 30, 2022 at 9AM CT filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.(Stover, Chad) (Entered: 06/23/2022)
06/23/2022	158	RESPONSE TO OBJECTIONS by BearBox LLC, Austin Storms re 146 Objection to Report and Recommendations, . (Mayo, Andrew) (Entered: 06/23/2022)
06/23/2022	159	NOTICE to Take Deposition of Jennifer Vanderhart on June 30, 2022 filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 06/23/2022)
06/24/2022	160	REDACTED VERSION of 153 Opening Brief in Support, by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 06/24/2022)
06/24/2022	161	REDACTED VERSION of 154 Declaration by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit A-B)(Mayo, Andrew) Modified on 6/27/2022 (dlw). (Entered: 06/24/2022)
06/27/2022	162	NOTICE OF SERVICE of Reply Expert Report of David R. Duski filed by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 06/27/2022)
06/29/2022	163	REDACTED VERSION of 149 Opening Brief in Support, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 06/29/2022)
06/29/2022	164	REDACTED VERSION of 150 Statement by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 06/29/2022)

06/29/2022	165	REDACTED VERSION of 151 Declaration, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1-23)(Stover, Chad) (Main Document 165 replaced on 7/6/2022) (dlw). (Attachment 1 replaced on 7/6/2022) (dlw). (Entered: 06/29/2022)
06/30/2022	166	ANSWER to 145 Answer to Amended Complaint,, Counterclaim, by BearBox LLC, Austin Storms.(Mayo, Andrew) (Entered: 06/30/2022)
07/08/2022	167	MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order)(Stover, Chad) Modified on 7/11/2022 (dlw). (Entered: 07/08/2022)
07/08/2022	168	[SEALED] OPENING BRIEF in Support re 167 MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. Answering Brief/Response due date per Local Rules is 7/22/2022. (Attachments: # 1 Certificate of Service)(Stover, Chad) Modified on 7/11/2022 (dlw). (Entered: 07/08/2022)
07/08/2022	169	[SEALED] STATEMENT re 168 Opening Brief in Support, 167 MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski // Supplemental Concise Statement of Undisputed Material Facts in Support of Motion for Summary Judgment by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certificate of Service)(Stover, Chad) Modified on 7/11/2022 (dlw). (Entered: 07/08/2022)
07/08/2022	170	[SEALED] DECLARATION of Adam M. Kaufmann re 168 Opening Brief in Support, 167 MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski, 169 Statement, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 24, # 2 Exhibit 25, # 3 Exhibit 26, # 4 Exhibit 27, # 5 Exhibit 28, # 6 Exhibit 29, # 7 Certificate of Service)(Stover, Chad) Modified on 7/11/2022 (dlw). (Entered: 07/08/2022)
07/15/2022	171	REDACTED VERSION of 168 Opening Brief in Support, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Collins, Kevin) (Entered: 07/15/2022)
07/15/2022	172	REDACTED VERSION of 169 Statement, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 07/15/2022)
07/15/2022	173	REDACTED VERSION of 170 Declaration, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 24-29)(Stover, Chad) (Entered: 07/15/2022)
07/19/2022	174	[SEALED] ANSWERING BRIEF in Opposition re 152 MOTION to Preclude Certain Testimony of Dr. Mark Ehsani filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. Reply Brief due date per 147 Stipulation and Order is 7/29/2022. (Attachments: # 1 Certificate of Service)(Stover, Chad) Modified on 7/20/2022 (dlw). (Entered: 07/19/2022)
07/19/2022	175	[SEALED] DECLARATION of Adam M. Kaufmann re 174 Answering Brief in Opposition by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Certificate of Service)(Stover, Chad) Modified on 7/20/2022 (dlw). (Entered: 07/19/2022)
07/19/2022	176	[SEALED] ANSWERING BRIEF in Opposition re 148 MOTION for Summary Judgment filed by BearBox LLC, Austin Storms. Reply Brief due date per 147 Stipulation and Order is 7/29/2022. (Mayo, Andrew) Modified on 7/20/2022 (dlw). (Entered: 07/19/2022)

07/19/2022	177	[SEALED] STATEMENT re 150 Statement // Plaintiffs' Response to Defendants' Concise Statement of Facts in Support of Defendants' Motion for Summary Judgment by BearBox LLC, Austin Storms. (Mayo, Andrew) Modified on 7/20/2022 (dlw). (Entered: 07/19/2022)
07/19/2022	178	[SEALED] STATEMENT // Plaintiffs' Separate Concise Statement of Material Facts for Trial Regarding its Inventorship and Conversion Claims by BearBox LLC, Austin Storms. (Mayo, Andrew) Modified on 7/20/2022 (dlw). (Entered: 07/19/2022)
07/19/2022	179	[SEALED] DECLARATION of Chelsea Murray re 176 Answering Brief in Opposition by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Exhibit E, # 6 Exhibit F, # 7 Exhibit G, # 8 Exhibit H, # 9 Exhibit I, # 10 Exhibit J, # 11 Exhibit K, # 12 Exhibit L, # 13 Exhibit M, # 14 Exhibit N, # 15 Exhibit O, # 16 Exhibit P, # 17 Exhibit Q, # 18 Exhibit R, # 19 Exhibit S, # 20 Exhibit T, # 21 Exhibit U, # 22 Exhibit V, # 23 Exhibit W, # 24 Exhibit X, # 25 Exhibit Y, # 26 Exhibit Z, # 27 Exhibit AA, # 28 Exhibit BB, # 29 Exhibit CC, # 30 Exhibit DD)(Mayo, Andrew) Modified on 7/20/2022 (dlw). (Entered: 07/19/2022)
07/22/2022	180	[SEALED] ANSWERING BRIEF in Opposition re 167 MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski filed by BearBox LLC, Austin Storms.Reply Brief due date per Local Rules is 7/29/2022. (Mayo, Andrew) (Entered: 07/22/2022)
07/22/2022	181	[SEALED] DECLARATION of Chelsea Murray re 180 Answering Brief in Opposition by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit EE-OO)(Mayo, Andrew) Modified on 7/25/2022 (dlw). (Entered: 07/22/2022)
07/22/2022	182	[SEALED] STATEMENT re 169 Statement // Plaintiffs' Response to Defendants' Supplemental Concise Statement of Facts in Support of Motion for Summary Judgment by BearBox LLC, Austin Storms. (Mayo, Andrew) Modified on 7/25/2022 (dlw). (Entered: 07/22/2022)
07/22/2022	183	[SEALED] STATEMENT // Plaintiffs' Separate Concise Statement of Material Facts for Trial Regarding Damages by BearBox LLC, Austin Storms. (Mayo, Andrew) Modified on 7/25/2022 (dlw). (Entered: 07/22/2022)
07/26/2022	184	REDACTED VERSION of 174 Answering Brief in Opposition, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 07/26/2022)
07/26/2022	185	REDACTED VERSION of 175 Declaration, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1-2)(Stover, Chad) (Entered: 07/26/2022)
07/27/2022	186	REDACTED VERSION of 176 Answering Brief in Opposition by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 07/27/2022)
07/27/2022	187	REDACTED VERSION of 177 Statement, by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 07/27/2022)
07/27/2022	188	REDACTED VERSION of 178 Statement by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 07/27/2022)
07/27/2022	189	REDACTED VERSION of 179 Declaration by BearBox LLC, Austin Storms. (Mayo, Andrew) Modified on 7/28/2022 (dlw). (Entered: 07/27/2022)
07/29/2022	190	[SEALED] REPLY BRIEF re 152 MOTION to Preclude Certain Testimony of Dr. Mark Ehsani filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 07/29/2022)

07/29/2022	191	[SEALED] REPLY BRIEF re 167 MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certificate of Service)(Stover, Chad) (Entered: 07/29/2022)
07/29/2022	192	[SEALED] DECLARATION of Adam M. Kaufmann re 191 Reply Brief by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 43, # 2 Certificate of Service)(Stover, Chad) Modified on 8/1/2022 (dlw). (Entered: 07/29/2022)
07/29/2022	193	[SEALED] STATEMENT re 183 Statement // Response to Plaintiffs' Separate Concise Statement of Material Facts for Trial Regarding Damages by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certificate of Service)(Stover, Chad) Modified on 8/1/2022 (dlw). (Entered: 07/29/2022)
07/29/2022	194	[SEALED] STATEMENT re 178 Statement // Response to Plaintiffs' Separate Concise Statement of Material Facts for Trial Regarding Inventorship and Conversion Claims by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certificate of Service)(Stover, Chad) Modified on 8/1/2022 (dlw). (Entered: 07/29/2022)
07/29/2022	195	[SEALED] REPLY BRIEF re 148 MOTION for Summary Judgment filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certificate of Service)(Stover, Chad) (Entered: 07/29/2022)
07/29/2022	196	[SEALED] DECLARATION of Adam M. Kaufmann re 195 Reply Brief by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 30-42, # 2 Certificate of Service)(Stover, Chad) Modified on 8/1/2022 (dlw). (Entered: 07/29/2022)
08/02/2022	197	REDACTED VERSION of 180 Answering Brief in Opposition, by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 08/02/2022)
08/02/2022	198	REDACTED VERSION of 181 Declaration by BearBox LLC, Austin Storms. (Mayo, Andrew) Modified on 8/2/2022 (dlw). (Entered: 08/02/2022)
08/02/2022	199	REDACTED VERSION of 182 Statement by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 08/02/2022)
08/02/2022	200	REDACTED VERSION of 183 Statement by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 08/02/2022)
08/04/2022	201	REQUEST for Oral Argument by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara re 148 MOTION for Summary Judgment , 167 MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski. (Stover, Chad) (Entered: 08/04/2022)
08/05/2022	202	REDACTED VERSION of 191 Reply Brief, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 08/05/2022)
08/05/2022	203	REDACTED VERSION of 192 Declaration by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 43)(Stover, Chad) (Entered: 08/05/2022)
08/05/2022	204	REDACTED VERSION of 193 Statement, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 08/05/2022)
08/05/2022	205	REDACTED VERSION of 194 Statement by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) Modified on 8/8/2022 (dlw). (Entered: 08/05/2022)

08/05/2022	206	REDACTED VERSION of 195 Reply Brief by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) Modified on 8/8/2022 (dlw). (Entered: 08/05/2022)
08/05/2022	207	REDACTED VERSION of 196 Declaration by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 30-42)(Stover, Chad) Modified on 8/8/2022 (dlw). (Entered: 08/05/2022)
08/05/2022	208	REDACTED VERSION of 190 Reply Brief by BearBox LLC, Austin Storms. (Mayo, Andrew) Modified on 8/8/2022 (dlw). (Entered: 08/05/2022)
09/07/2022		Case Reassigned to Judge Gregory B Williams. Please include the initials of the Judge (GBW) after the case number on all documents filed. (apk) (Entered: 09/07/2022)
09/28/2022	209	Letter to The Honorable Gregory B. Williams from Chad S.C. Stover regarding Defendants' request for oral argument re: their summary judgment and Dabuert motions - re 148 MOTION for Summary Judgment , 167 MOTION for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski, 201 Request for Oral Argument,. (Stover, Chad) (Entered: 09/28/2022)
09/29/2022	210	Letter to The Honorable Gregory B. Williams from Andrew C. Mayo regarding response to Defendant's September 28, 2022 letter. (Mayo, Andrew) (Entered: 09/29/2022)
10/05/2022	211	ORAL ORDER: In order to resolve Defendants' pending summary judgment motion (D.I. 148), IT IS HEREBY ORDERED that a Markman Hearing is now scheduled for 10/20/22, at 10:00 AM in Courtroom 6B. The Court is setting aside one (1) hour for the Markman hearing with the time split equally between the two sides. Any slide presentations the parties wish to use during the hearing shall be emailed (in PDF format) to gbw_civil@ded.uscourts.gov no later than 48 hours prior to the hearing with hard copies delivered to the Clerk's office within one hour thereafter. Based on the parties' construction of the disputed terms in their respective summary judgment briefing, the parties need not file additional briefing on this matter. ORDERED by Judge Gregory B. Williams on 10/5/22. (ntl) (Entered: 10/05/2022)
10/07/2022	212	MEMORANDUM OPINION. Signed by Judge Gregory B. Williams on 10/07/2022. (etg) (Entered: 10/07/2022)
10/07/2022	213	ORDER re 212 MEMORANDUM OPINION: Defendants' Objections (D.I. 146) to the Report are OVERRULED; The Report (D.I. 143) is ADOPTED; Defendants' Motion (D.I. 120) is GRANTED-IN-PART and DENIED-IN-PART; and Plaintiffs' unjust enrichment claim (Count VI) is dismissed with prejudice. Signed by Judge Gregory B. Williams on 10/7/2022. (etg) (Entered: 10/07/2022)
10/11/2022		Pro Hac Vice Attorney David M. Lisch for Raymond E. Cline, Jr., Lancium LLC, and Michael T. McNamara added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (mkr) (Entered: 10/11/2022)
10/18/2022	214	[SEALED] MOTION for Disclosure *of Third-Party Litigation Funding Arrangements* - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order, # 2 Exhibit A, # 3 Exhibit B, # 4 L.R. 7.1.1 Statement, # 5 Certificate of Service)Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 10/18/2022)
10/20/2022		Minute Entry for proceedings held before Judge Gregory B. Williams - Markman Hearing held on 10/20/2022. (Court Reporter M. Rolfe.) (ntl) (Entered: 10/20/2022)

10/24/2022	215	Letter to The Honorable Gregory B. Williams from Andrew C. Mayo regarding meet and confer following Markman hearing to address claim terms in dispute. (Mayo, Andrew) (Entered: 10/24/2022)
10/25/2022	216	REDACTED VERSION of 214 MOTION for Disclosure *of Third-Party Litigation Funding Arrangements* by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 7.1.1 Statement, # 2 Text of Proposed Order, # 3 Exhibit A, # 4 Exhibit B)(Stover, Chad) (Entered: 10/25/2022)
10/26/2022	217	MOTION for Pro Hac Vice Appearance of Attorney Benjamin T. Pendroff - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certification by Counsel to be Admitted Pro Hac Vice)Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 10/26/2022)
10/27/2022		SO ORDERED D.I. 217 MOTION for Pro Hac Vice Appearance of Attorney Benjamin T. Pendroff filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. Ordered by Judge Christopher J. Burke on 10/27/22. (mlc) (Entered: 10/27/2022)
10/28/2022	218	MEMORANDUM OPINION re claim construction. Signed by Judge Gregory B. Williams on 10/28/22.This order has been emailed to local counsel. (ntl) Modified on 11/8/2022 (ntl). (Main Document 218 replaced on 11/8/2022) (ntl). (Entered: 10/28/2022)
10/28/2022	219	ORDER re 218 Memorandum Opinion regarding claim construction. Signed by Judge Gregory B. Williams on 10/28/22. (ntl) (Entered: 10/28/2022)
10/28/2022	220	ORAL ORDER: Because the Memorandum Opinion is filed under seal, IT IS HEREBY ORDERED that the parties shall meet and confer and, no later than November 3, 2022, submit a joint proposed redacted version, accompanied by a supporting memorandum, detailing how, under applicable law, the Court may approve any requested redactions. In the absence of a timely, compliant request, the Court will unseal the entire opinion. ORDERED by Judge Gregory B. Williams on 10/28/22. (ntl) (Entered: 10/28/2022)
10/28/2022	221	MOTION for Pro Hac Vice Appearance of Attorney John J. Lucas - filed by BearBox LLC, Austin Storms. Motions referred to Christopher J. Burke.(Mayo, Andrew) (Entered: 10/28/2022)
10/28/2022		Pro Hac Vice Attorney Benjamin Pendroff for Raymond E. Cline, Jr, Lancium LLC, and Michael T. McNamara added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (mkr) (Entered: 10/28/2022)
10/31/2022		SO ORDERED D.I. 221 MOTION for Pro Hac Vice Appearance of Attorney John J. Lucas filed by BearBox LLC, Austin Storms.Ordered by Judge Christopher J. Burke on 10/31/22. (mlc) (Entered: 10/31/2022)
10/31/2022		Pro Hac Vice Attorney John J. Lucas for BearBox LLC added for electronic noticing. Pursuant to Local Rule 83.5 (d)., Delaware counsel shall be the registered users of CM/ECF and shall be required to file all papers. (mpb) (Entered: 10/31/2022)
10/31/2022	222	MOTION to Bifurcate *Defendants' Motion for Bifurcation and to Expedite Briefing and Consideration of This Motion* - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order Proposed Order)Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 10/31/2022)
10/31/2022	223	[SEALED] OPENING BRIEF in Support re 222 MOTION to Bifurcate *Defendants' Motion for Bifurcation and to Expedite Briefing and Consideration of This Motion* filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.Answering

		Brief/Response due date per Local Rules is 11/14/2022. (Attachments: # 1 Certificate of Service)(Stover, Chad) (Entered: 10/31/2022)
11/01/2022		Motions No Longer Referred: 222 MOTION to Bifurcate *Defendants' Motion for Bifurcation and to Expedite Briefing and Consideration of This Motion* (mlc) (Entered: 11/01/2022)
11/01/2022	224	[SEALED] ANSWERING BRIEF in Opposition re 214 MOTION for Disclosure *of Third-Party Litigation Funding Arrangements* filed by BearBox LLC, Austin Storms.Reply Brief due date per Local Rules is 11/8/2022. (Mayo, Andrew) (Entered: 11/01/2022)
11/03/2022	225	STIPULATION to extend briefing schedule in connection with motion for bifurcation by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 11/03/2022)
11/03/2022	226	Letter to The Honorable Gregory B. Williams from Andrew C. Mayo regarding redactions to October 28, 2022 memorandum opinion. (Mayo, Andrew) (Entered: 11/03/2022)
11/04/2022		SO ORDERED, re 225 STIPULATION to extend briefing schedule in connection with motion for bifurcation by BearBox LLC, Austin Storms. Signed by Judge Gregory B. Williams on 11/4/2022. (etg) (Entered: 11/04/2022)
11/08/2022	227	[SEALED] REPLY BRIEF re 214 MOTION for Disclosure *of Third-Party Litigation Funding Arrangements* filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Certificate of Service)(Stover, Chad) (Entered: 11/08/2022)
11/08/2022		Document Unsealed -- 218 Memorandum Opinion unsealed. (ntl) (Entered: 11/08/2022)
11/09/2022	228	REDACTED VERSION of 224 Answering Brief in Opposition by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 11/09/2022)
11/10/2022	229	[SEALED] ANSWERING BRIEF in Opposition re 222 MOTION to Bifurcate *Defendants' Motion for Bifurcation and to Expedite Briefing and Consideration of This Motion* filed by BearBox LLC, Austin Storms.Reply Brief due date per Local Rules is 11/17/2022. (Mayo, Andrew) (Entered: 11/10/2022)
11/14/2022	230	MEMORANDUM OPINION re pending motions. Signed by Judge Gregory B. Williams on 11/14/22. (ntl) (Main Document replaced and docket text updated on 1/12/2023) (etg). (Entered: 11/14/2022)
11/14/2022	231	ORDER re 230 Memorandum Opinion -- 1. Lancium's First Motion for Summary Judgment (DJ. 148) is GRANTED-IN PART and DENIED-IN-PART; 2. Count V of BearBox's Second Amended Complaint (DJ. 103) is DISMISSED WITH PREJUDICE; 3. Lancium's Second Motion for Summary Judgment Regarding Damages and Motion to Exclude Opinions of David Duski (DJ. 167) is DENIED AS MOOT; and 4. Lancium's Motion to Bifurcate BearBox's Patent Inventorship Claims from the Conversion Claims (DJ. 222) is DENIED AS MOOT. Signed by Judge Gregory B. Williams on 11/14/22. (ntl) (Entered: 11/14/2022)
11/14/2022	232	ORAL ORDER: Having determined that the only issue remaining for the Court to hear is Plaintiffs' claims of sole inventorship, or, alternatively, joint inventorship (D.I. 231), and since inventorship is an issue solely for the Court to determine, see, e.g., 35 U.S.C. § 256; Shum v. Intel Corp., 499 F.3d 1272, 1277 (Fed. Cir. 2007) (holding that "an action for correction of inventorship under § 256, standing alone, is an equitable claim to which no right to a jury trial attaches"), IT IS HEREBY ORDERED that the 4-day jury trial scheduled to begin on December 5, 2022 (D.I. 35 at 15) is now scheduled as a 3-day bench trial beginning on Tuesday, December 6, 2022. The pretrial conference will be held

		on November 22, 2022, to begin at 3:00 PM (rather than at 4:30 PM). ORDERED by Judge Gregory B. Williams on 11/14/22. (ntl) (Entered: 11/14/2022)
11/14/2022	233	ORAL ORDER: The Court, having reviewed Defendants' "Motion for Disclosure of Third-Party Litigation Funding Arrangements" (the "Motion"), (D.I. 214), hereby ORDERS as follows: The Court's Order here does not intend to address whether disclosure of third-party litigation funding arrangements should or should not, as a general matter, be required at the outset of most or all civil cases in this District. Instead, it focuses solely on the unique facts and circumstances at play in this case (wherein no such disclosure order had previously been entered by the Court). In light of the particular record at issue here, the Court DENIES Defendants' Motion (with one exception, set out below), for the following reasons.; (1) It does not appear that Defendants' request -- i.e., that Plaintiffs disclose certain information relating to all third-party funders for this litigation (the "requested information") -- is relevant to any claims or defenses at issue in the case. Although Defendants briefly suggested that the requested information might be relevant to standing, (D.I. 214 at 3), Plaintiffs noted in response that they are not enforcing a patent in this lawsuit, but instead seeking to correct inventorship of a patent, (D.I. 224 at 2). The Court does not see how, in those circumstances, there could be a standing issue at play here.; (2) Even if the requested information was somehow relevant to a claim or defense in this litigation, the Motion appears to be very untimely. The deposition at which Defendants learned that an entity known as Great American Mining has paid for certain costs and fees incurred in this litigation occurred in February 2022. Yet Defendants did not file the Motion until October 2022. (See D.I. 224 at 1) Defendants provide no explanation as to why they did not file the Motion earlier. Nor is it clear why Defendants did not ask further questions during the deposition (wherein they learned of the identity of the third-party funder) in order to obtain the additional information that they now belatedly seek. While Defendants vaguely suggest that the requested information is needed to "promote efficiency," (D.I. 227 at 1), it is not efficient to be making untimely requests for discovery-related information on the eve of trial.; (3) Lastly, Defendants argue that the requested information is "crucial to ensuring that this Court can remain clear of any conflicts." (D.I. 214 at 3; see also D.I. 227 at 1) To be sure, the Court has a real interest in doing what it can to reasonably assess any potential conflict of interest that might be present in a litigation matter. But the Court is now aware of the identity of the entity (i.e., Great American Mining) that has paid for certain of Plaintiffs' costs and fees incurred in this litigation. The Court is aware of no conflict that it has in light of this entity's involvement. And it is not clear to the Court how any of the requested information would be needed for it or the District Judge to be able to make this conflict-related assessment as to Great American Mining.; and (4) The Court assumes that, in light of the tenor of Plaintiffs' answering brief, there is no other entity (other than Great American Mining) that is serving as a third-party funder in this case. But just to ensure that the Court is understanding the record correctly, by no later than November 21, 2022, the Court ORDERS that Plaintiffs shall submit a letter confirming that there are no other third-party funders (or, if there are, listing them). Ordered by Judge Christopher J. Burke on 11/14/2022. (mlc) (Entered: 11/14/2022)
11/15/2022	234	MEMORANDUM OPINION re 152 motion to exclude certain testimony of Dr. Mark Ehsani. Signed by Judge Gregory B. Williams on 11/15/22. (ntl) (Main Document replaced and docket text updated on 1/12/2023) (etg). (Entered: 11/15/2022)
11/15/2022	235	ORDER re 234 Memorandum Opinion -- 152 MOTION to Preclude Certain Testimony of Dr. Mark Ehsani filed by BearBox LLC, Austin Storms is GRANTED-IN-PART and DENIED-IN-PART. Signed by Judge Gregory B. Williams on 11/15/22. (ntl) (Entered: 11/15/2022)
11/15/2022	236	MOTION to Strike *Emergency Motion to Strike the Supplemental Expert Report of Plaintiffs' Expert, Dr. McClellan, and Motion to Expedite Briefing on the Same* - filed by

		Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 11/15/2022)
11/15/2022	237	[SEALED] Letter to The Honorable Gregory B. Williams from Chad S.C. Stover regarding Defendants' Opening Letter Brief in Support of its Emergency Motion to Stike Plaintffs' Newly Disclosed, Untimely Expert Report and Request for Expedited Briefing - re 236 MOTION to Strike *Emergency Motion to Strike the Supplemental Expert Report of Plaintiffs' Expert, Dr. McClellan, and Motion to Expedite Briefing on the Same*. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3, # 4 Certificate of Service)(Stover, Chad) (Entered: 11/15/2022)
11/15/2022		Motions No Longer Referred: 236 MOTION to Strike *Emergency Motion to Strike the Supplemental Expert Report of Plaintiffs' Expert, Dr. McClellan, and Motion to Expedite Briefing on the Same* (mlc) (Entered: 11/15/2022)
11/15/2022	238	ORAL ORDER: Having reviewed Defendants' Motion for Expedited Briefing on their Emergency Motion to Strike (D.I. 236; D.I. 237), IT IS HEREBY ORDERED that not later than seventy-two (72) hours from the entry of this Order, Plaintiffs shall file their answering brief addressing Defendants' Motion. IT IS FURTHER ORDERED that not later than forty-eight (48) hours thereafter, Defendants must file their reply brief responding to Plaintiffs' Response. The letter briefing shall be consistent with Judge Williams' scheduling order for letter briefing related to motions to strike. ORDERED by Judge Gregory B. Williams on 11/15/22. (ntl) Modified on 11/15/2022 (ntl). (Entered: 11/15/2022)
11/15/2022	239	[SEALED] Proposed Pretrial Order by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit 1-13)(Mayo, Andrew) (Entered: 11/15/2022)
11/17/2022	240	ORAL ORDER: IT IS HEREBY ORDERED that the pretrial conference is rescheduled to November 29, 2022, to begin at 3:00 PM in Courtroom 6B. ORDERED by Judge Gregory B. Williams on 11/17/22. (ntl) (Entered: 11/17/2022)
11/18/2022	241	[SEALED] Letter to The Honorable Gregory B. Williams from Andrew C. Mayo regarding response to defendants' motion to strike. (Attachments: # 1 Exhibit A-K)(Mayo, Andrew) (Entered: 11/18/2022)
11/20/2022	242	Letter to The Honorable Gregory B. Williams from Chad S.C. Stover regarding Reply in Support of Defendants' Emergency Motion to Stike Plaintiffs' Newly Disclosed, Untimely Expert Report and Request for Expedited Briefing - re 241 Letter, 237 Letter,,. (Stover, Chad) (Entered: 11/20/2022)
11/21/2022	243	[SEALED] Letter to The Honorable Christopher J. Burke from Andrew C. Mayo regarding November 14, 2022 Oral Order. (Mayo, Andrew) (Entered: 11/21/2022)
11/22/2022	244	REDACTED VERSION of 223 Opening Brief in Support, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 11/22/2022)
11/22/2022	245	REDACTED VERSION of 227 Reply Brief by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 11/22/2022)
11/22/2022	246	REDACTED VERSION of 237 Letter,, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3)(Stover, Chad) (Entered: 11/22/2022)
11/23/2022	247	MEMORANDUM ORDER re 236 MOTION to Strike *Emergency Motion to Strike the Supplemental Expert Report of Plaintiffs' Expert, Dr. McClellan, and Motion to Expedite Briefing on the Same* - filed by Raymond E. Cline, Jr., Michael T. McNamara, Lancium LLC. Signed by Judge Gregory B. Williams on 11/23/2022.This order has been emailed

		to local counsel. (etg) Modified on 11/30/2022 (ntl). (Main Document 247 replaced on 11/30/2022) (ntl). (Entered: 11/23/2022)
11/28/2022	248	NOTICE of Appearance by William J. Burton on behalf of Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara (Burton, William) (Entered: 11/28/2022)
11/28/2022	249	REDACTED VERSION of 243 Letter by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 11/28/2022)
11/29/2022		Minute Entry for proceedings held before Judge Gregory B. Williams - Pretrial Conference held on 11/29/2022. (Court Reporter M. Rolfe.) (ntl) (Entered: 11/29/2022)
11/29/2022	250	ORDER regarding the parties' motions in limine. Signed by Judge Gregory B. Williams on 11/29/22. (ntl) (Entered: 11/29/2022)
11/29/2022	251	Letter to The Honorable Gregory B. Williams from Andrew C. Mayo regarding redactions to November 23, 2022 sealed memorandum order. (Mayo, Andrew) (Entered: 11/29/2022)
11/30/2022		Document Unsealed -- 247 Memorandum Order unsealed. (ntl) (Entered: 11/30/2022)
12/02/2022	252	Official Transcript of Pretrial Conference held on 11.29.2022 before Judge Gregory B. Williams. Court Reporter/Transcriber Michele Rolfe,Email: michele_rolfe@ded.uscourts.gov. Transcript may be viewed at the court public terminal or order/purchased through the Court Reporter/Transcriber before the deadline for Release of Transcript Restriction. After that date, it may be obtained through PACER. Redaction Request due 12/27/2022. Redacted Transcript Deadline set for 1/3/2023. Release of Transcript Restriction set for 3/2/2023. (Rolfe, Michele) (Entered: 12/02/2022)
12/02/2022	253	[SEALED] Letter to The Honorable Gregory B. Williams from Andrew C. Mayo regarding revised trial exhibit list. (Attachments: # 1 Exhibit 1 - PTX201, # 2 Exhibit 2 - PTX922, # 3 Exhibit 3 - Revised Trial Exhibit List)(Mayo, Andrew) (Entered: 12/02/2022)
12/06/2022		Minute Entry for proceedings held before Judge Gregory B. Williams - Bench Trial (Day 1) held on 12/6/2022. (Court Reporter M. Rolfe.) (ntl) (Entered: 12/07/2022)
12/07/2022	254	Letter to The Honorable Gregory B. Williams from Andrew C. Mayo regarding Plaintiffs' Citations in Response to Defendants' Objections to Dr. McClellan's Demonstrative Slides. (Mayo, Andrew) (Entered: 12/07/2022)
12/07/2022	255	Letter to The Honorable Gregory B. Williams from Chad S.C. Stover regarding response to Plaintiffs' December 7, 2022 letter re: Dr. McClellan's supplemental expert report - re 254 Letter. (Stover, Chad) (Entered: 12/07/2022)
12/07/2022		Minute Entry for proceedings held before Judge Gregory B. Williams - Bench Trial (Day 2) held on 12/7/2022. (Court Reporter M. Rolfe.) (ntl) (Entered: 12/08/2022)
12/08/2022		Minute Entry for proceedings held before Judge Gregory B. Williams - Bench Trial completed on 12/8/2022. (Court Reporter M. Rolfe.) (ntl) (Entered: 12/08/2022)
01/11/2023	256	POST TRIAL BRIEF by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 01/11/2023)
01/11/2023	257	Proposed Findings of Fact by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 01/11/2023)
01/12/2023		Document Unsealed -- 230 Memorandum Opinion unsealed. (etg) (Entered: 01/12/2023)
01/12/2023		Document Unsealed -- 234 Memorandum Opinion unsealed. (etg) (Entered: 01/12/2023)

01/25/2023	258	POST TRIAL BRIEF *(Response)* by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 01/25/2023)
01/25/2023	259	Proposed Findings of Fact by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 01/25/2023)
02/01/2023	260	POST TRIAL BRIEF *(Reply)* by BearBox LLC, Austin Storms. (Attachments: # 1 Exhibit A)(Mayo, Andrew) (Entered: 02/01/2023)
02/08/2023	261	POST TRIAL BRIEF *// Sur-Reply* by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 1)(Stover, Chad) (Entered: 02/08/2023)
03/06/2023	262	OPINION regarding bench trial -- The Court finds that Plaintiffs have not met their burdens to establish their sole and/or joint inventorship claims. Accordingly, the Court will enter judgment in favor of Defendants. Signed by Judge Gregory B. Williams on 3/6/23. (ntl) (Entered: 03/06/2023)
03/06/2023	263	ORDER re 262 Opinion -- The parties shall submit, by no later than March 27, 2023, a proposed order by which the Court may enter final judgment consistent with the Opinion issued this day. Signed by Judge Gregory B. Williams on 3/6/23. (ntl) (Entered: 03/06/2023)
03/27/2023	264	PROPOSED CONSENT JUDGMENT *(Proposed Final Judgment)* by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 03/27/2023)
03/28/2023	265	ORAL ORDER: IT IS HEREBY ORDERED that, by no later than April 3, 2023, Defendants shall file a letter with the Court indicating whether they oppose entry of the [Proposed] Final Judgment (D.I. 264). If Defendants oppose any of the specific language of the [Proposed] Final Judgment, Defendants should meet and confer with Plaintiffs in attempt to resolve any disagreements and, by no later than April 3, 2023, the parties should submit a joint [Proposed] Final Judgment that identifies any remaining disagreements on specific language and includes each side's respective proposed language. The Court will resolve any remaining disagreements on proposed specific language before entering the Final Judgment. ORDERED by Judge Gregory B. Williams on 3/28/23. (ntl) (Entered: 03/28/2023)
03/29/2023	266	Letter to The Honorable Gregory B. Williams from Chad S.C. Stover regarding no objections by Defendants to the Proposed Final Judgment filed on March 27, 2023 - re 264 Proposed Consent Judgment, 265 Order,,,. (Stover, Chad) (Entered: 03/29/2023)
04/05/2023	267	FINAL JUDGMENT in favor of Defendants and against Plaintiffs (See Judgment for further details) (CASE CLOSED). Signed by Judge Gregory B. Williams on 4/5/23. (ntl) (Entered: 04/05/2023)
04/05/2023	268	Report to the Commissioner of Patents and Trademarks. (ntl) (Entered: 04/05/2023)
04/19/2023	269	MOTION for Attorney Fees *and Expenses* - filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Text of Proposed Order)Motions referred to Christopher J. Burke.(Stover, Chad) (Entered: 04/19/2023)
04/19/2023	270	[SEALED] OPENING BRIEF in Support re 269 MOTION for Attorney Fees *and Expenses* filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara.Answering Brief/Response due date per Local Rules is 5/3/2023. (Attachments: # 1 Certificate of Service)(Stover, Chad) (Entered: 04/19/2023)
04/19/2023	271	DECLARATION re 270 Opening Brief in Support, 269 MOTION for Attorney Fees *and Expenses // Declaration of Adam Kaufmann* by Raymond E. Cline, Jr, Lancium LLC,

		Michael T. McNamara. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3, # 4 Exhibit 4, # 5 Exhibit 5, # 6 Exhibit 6)(Stover, Chad) (Entered: 04/19/2023)
04/19/2023		Motion No Longer Referred to Judge Burke: 269 MOTION for Attorney Fees *and Expenses* (dlb) (Entered: 04/20/2023)
05/01/2023	272	REDACTED VERSION of 270 Opening Brief in Support, by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Stover, Chad) (Entered: 05/01/2023)
05/03/2023	273	ANSWERING BRIEF in Opposition re 269 MOTION for Attorney Fees *and Expenses* filed by BearBox LLC, Austin Storms.Reply Brief due date per Local Rules is 5/10/2023. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3, # 4 Exhibit 4, # 5 Exhibit 5, # 6 Exhibit 6, # 7 Exhibit 7, # 8 Exhibit 8, # 9 Exhibit 9, # 10 Exhibit 10, # 11 Exhibit 11, # 12 Exhibit 12, # 13 Exhibit 13, # 14 Exhibit 14, # 15 Exhibit 15, # 16 Exhibit 16, # 17 Exhibit 17, # 18 Exhibit 18, # 19 Exhibit 19)(Mayo, Andrew) (Main Document 273 replaced on 5/4/2023) (apk). (Entered: 05/03/2023)
05/04/2023		CORRECTING ENTRY: D.I. 273 replaced to include a "Table of Authorities" per counsels request. (apk) (Entered: 05/04/2023)
05/04/2023	274	NOTICE OF APPEAL to the Federal Circuit of 267 Judgment . Appeal filed by BearBox LLC, Austin Storms. (Mayo, Andrew) (Entered: 05/04/2023)
05/04/2023		APPEAL - Credit Card Payment received re 274 Notice of Appeal (Federal Circuit) filed by BearBox LLC, Austin Storms. (Filing fee $505, receipt number ADEDC-4128621.) (Mayo, Andrew) (Entered: 05/04/2023)
05/05/2023		Notification regarding 274 Notice of Appeal (Federal Circuit) sent to Reporter Rolfe (mpb) (Entered: 05/05/2023)
05/05/2023		Notice of Appeal and Docket Sheet to US Court of Appeals for the Federal Circuit re 274 Notice of Appeal (Federal Circuit). (mpb) (Entered: 05/05/2023)
05/10/2023	275	REPLY BRIEF re 269 MOTION for Attorney Fees *and Expenses* filed by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara. (Attachments: # 1 Exhibit 7)(Stover, Chad) (Entered: 05/10/2023)
05/17/2023	276	REQUEST for Oral Argument by Raymond E. Cline, Jr, Lancium LLC, Michael T. McNamara re 269 MOTION for Attorney Fees *and Expenses*. (Stover, Chad) (Entered: 05/17/2023)
05/22/2023	277	NOTICE of Docketing Record on Appeal from USCA for the Federal Circuit re 274 Notice of Appeal (Federal Circuit) filed by BearBox LLC, Austin Storms. USCA Case Number 2023-1922. (ntl) (Entered: 05/23/2023)
05/24/2023	278	ORAL ORDER: Having reviewed Defendants' request for oral argument on their Motion for Fees and Expenses (D.I. 269), IT IS HEREBY ORDERED that an oral argument is scheduled for Thursday, June 8, 2023 at 1:00 p.m. in Courtroom 6B. Each side will be allocated up to thirty (30) minutes to present its argument. The parties shall provide the Court with electronic and hard copies of any presentation slides to be used during the oral argument by 2:00 p.m. on June 7, 2023. ORDERED by Judge Gregory B. Williams on 5/24/23. (ntl) (Entered: 05/24/2023)
06/05/2023	279	NOTICE of (Plaintiffs' Notice of Supplemental Authority in connection with Opposition to Defendants' Motion for Fees and Expenses (D.I. 269)) by BearBox LLC, Austin Storms (Attachments: # 1 Ex. A [Federal Circuit opinion])(Mayo, Andrew) (Entered: 06/05/2023)

06/08/2023		Minute Entry for proceedings held before Judge Gregory B. Williams - Oral Argument held on 6/8/2023. (Court Reporter M. Rolfe.) (ntl) (Entered: 06/08/2023)

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Billable Pages:	30	**Cost:**	3.00

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR. Defendants.	)	C.A. No. **JURY TRIAL DEMANDED**

<u>COMPLAINT</u>

Plaintiffs BearBox LLC ("BearBox") and Austin Storms (collectively, "Plaintiffs") bring this action against Lancium LLC ("Lancium"), Michael T. McNamara, and Raymond E. Cline, Jr. (collectively "Defendants") to correct the inventorship of U.S. Patent No. 10,608,433 (the "'433 Patent") and to recover damages, injunctive relief, declaratory relief, and other remedies for Defendants' wrongful actions to obtain, misuse, disclose, and claim as their own Plaintiffs' proprietary cryptocurrency mining technology. Plaintiffs further allege as follows:

INTRODUCTION

1. This case is about the Defendants' theft of inventions that rightfully belong to Plaintiffs.

2. Plaintiffs developed an energy-efficient cryptocurrency mining system and related methods that reduce the inefficiency and environmental impact of energy-expensive mining operations by better utilizing available energy resources to increase stability of the energy grid, minimize a mining operation's impact on peak-demand, and also alleviate electricity

undersupply and/or oversupply conditions (the "BearBox Technology"). The BearBox Technology can be used to mine cryptocurrency, such as Bitcoin.

3. The Defendants induced the Plaintiffs to disclose the BearBox Technology to them under the guise of a possible business deal between Defendants and Plaintiffs to jointly commercialize the BearBox Technology. Before disclosing the BearBox Technology to Defendants, Plaintiffs obtained assurances of confidentiality from Defendants.

4. Rather than keeping the BearBox Technology confidential and using it in furtherance of a business relationship with Plaintiffs, the Defendants stole the BearBox Technology from Plaintiffs by converting and misappropriating it and claiming it as their own. Defendants filed a U.S. patent application that wrongfully disclosed the BearBox Technology to the U.S. Patent and Trademark Office and ultimately to the public. And by obtaining the '433 Patent with claims directed to the BearBox Technology, the Defendants have wrongfully obtained a patent covering the BearBox Technology and wrongfully claimed the BearBox Technology as their own.

5. Plaintiffs bring this action to correct the named inventors on the '433 Patent. The inventions claimed in the '433 Patent are inventions conceived by Storms, founder and president of BearBox.

PARTIES

6. Plaintiff BearBox LLC ("BearBox") is a limited liability company organized and existing under the laws of Louisiana with its principal place of business at 4422 Highway 22, Mandeville, Louisiana 70471.

7. Plaintiff Austin Storms is an individual residing in Mandeville, Louisiana.

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8. On information and belief, Defendant Lancium is a Delaware limited liability company with its principal place of business at 6006 Thomas Rd, Houston, Texas 77041. On information and belief, Lancium has a registered agent capable of accepting service in this district, Harvard Business Services, Inc. with a place of business at 16192 Coastal Highway, Lewes, DE 19958.

9. On information and belief, Defendant Michael T. McNamara is the Chief Executive Officer and a founder of Lancium and resides in Newport Beach, California. Defendant McNamara is named as a purported inventor on the face of the ’433 Patent.

10. On information and belief, Defendant Raymond E. Cline, Jr. is the Chief Computing Officer of Lancium and resides in Houston, Texas. Defendant Cline is named as a purported inventor on the face of the ’433 Patent.

JURISDICTION

11. This is an action seeking correction of the named inventors of a United States patent under 35 U.S.C. § 256. As such, this action arises under the laws of the United States.

12. This Court has exclusive subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a) because the matter arises under an Act of Congress relating to patents, specifically 35 U.S.C. § 256.

13. This Court further has subject matter jurisdiction under 28 U.S.C. §§ 1331 because the matter arises under the trade secret laws of the United States, 18 U.S.C. § 1836.

14. The Court has supplemental jurisdiction under 28 U.S.C. § 1367 over all asserted claims under state law because those claims are so related to the claims in this action that arise under federal law that they form part of the same case or controversy.

15. The Court also has jurisdiction pursuant to 28 U.S.C. § 1332, as complete diversity of citizenship exists among the parties, and the amount in controversy exceeds $75,000. Plaintiff BearBox is a citizen of the State of Louisiana because it is organized under the laws of the State of Louisiana and has its principal place of business in the State of Louisiana. Plaintiff Storms is a citizen of the State of Louisiana because he resides in the State of Louisiana. In contrast, none of the Defendants are citizens of the State of Louisiana. Defendant Lancium is a citizen of the States of Delaware and Texas because it is organized under the laws of the State of Delaware and has its principal place of business in the State of Texas. Defendant McNamara is a citizen of the State of California because he resides in the State of California. Defendant Cline is a citizen of the State of Texas because he resides in the State of Texas. Therefore, because the Plaintiffs are both citizens of the State of Louisiana (and no other states) for purposes of diversity jurisdiction, and none of the Defendants are citizens of the State of Louisiana, complete diversity exists among the parties.

16. This Court has general personal jurisdiction over Lancium because it is organized under the laws of the State of Delaware and because it maintains an ongoing presence in this District at least through its registered agent.

17. This Court has specific personal jurisdiction over each of Defendants McNamara and Cline at least under Title 6 of the Delaware Code, § 18-109(a).

18. On information and belief, Defendant McNamara is the Chief Executive Officer of Lancium. On information and belief, as the Chief Executive Offer, McNamara participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

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19. McNamara is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from the interests of Lancium and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claims against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant McNamara together. Plaintiffs' claims against Defendant McNamara arise out of his exercise of his powers as Chief Executive Officer of Lancium.

20. On information and belief, Defendant Cline is the Chief Computing Officer of Lancium. On information and belief, as the Chief Computing Officer, Cline participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

21. Cline is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from Lancium's interest and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claim against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant Cline together. Plaintiffs' claims against Defendant Cline arise out of his exercise of his powers as Chief Computing Officer of Lancium.

22. The actions of Defendants McNamara and Cline establish sufficient minimum contacts with Delaware under Delaware law and the United States Constitution to give this Court personal jurisdiction over each of them.

23. As described below, each Defendant has committed acts giving rise to this action.

VENUE

24. Venue is proper in this District under 28 U.S.C. § 1391(b)(3) because there is no district in which an action may otherwise be brought as provided in § 1391(b) and Defendant Lancium is subject to the Court's personal jurisdiction with respect to this action.

PLAINTIFFS' PROPRIETARY CRYPTOCURRENCY MINING TECHNOLOGY

25. As of 2018, the amount of energy required to process computer algorithms to mine cryptocurrencies like Bitcoin was three times greater than the energy required to physically mine gold. Conventional mining of "copper, gold, platinum, and rare earth oxides are 4, 5, 7, and 9 megajoules to generate one U.S. dollars," while "it costs an average of 17 megajoules to mine $1 worth of bitcoin."[1] The large amount of energy required to mine cryptocurrencies can make such mining financially prohibitive, and even when financially lucrative, the large energy requirements make cryptocurrency mining harmful to the global environment, with studies showing carbon dioxide emissions from cryptocurrency mining "single-handedly rais[ing] global temperatures by 2 degrees by 2023." *Id.*

26. At the same time, some forms of electrical power generation are terribly inefficient. When producers of electrical power are unable to quickly adjust their operations in response to dynamically changing grid conditions, these producers frequently sell power at low or even negative prices until demand and market prices increase.

27. Because cryptocurrency mining is a computationally demanding process, it requires significant energy. As a result, industrial-scale cryptocurrency mining places a large

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[1] https://www.marketwatch.com/story/mining-bitcoin-is-3-times-more-expensive-than-mining-gold-research-paper-finds-2018-11-06

energy burden on the power grid, driving demand and costs as well as increasing the likelihood of grid component failure.

28. In late 2018 and early 2019, Austin Storms sought to address these problems by developing energy-efficient cryptocurrency mining systems and methods that reduce the environmental impact of energy-intensive mining operations. Storms conceived of a system that better uses available energy resources to increase the stability of the energy grid, minimize a mining operation's impact on peak-demand, and alleviate electricity undersupply and/or oversupply conditions, all while decreasing the overall energy costs of the mining operation and increasing its profitability.

29. Austin Storms conceived of and developed the BearBox Technology. Storms is the president and founder of BearBox. The BearBox Technology includes hardware and software components. Structurally, the BearBox Technology includes a housing for a plurality of miners (such as ASICs, graphics cards, or the like) under the direction of a smart controller(s).

30. The smart controller monitors various external factors, such as current and expected energy demand and pricing information, current and expected cryptocurrency pricing, and the like. Based on these external factors, the system may determine whether conditions are appropriate to mine cryptocurrency and, if so, subsequently mines the cryptocurrency. Optionally, the system also includes other components for cooling, air-filtration, and related features.

31. In the BearBox Technology, a controller (such as a power distribution unit, network interface, or the like) monitors various external factors, such as current and expected energy demand/pricing information, current and expected cryptocurrency pricing, and the like. Based on these external factors, the controller(s) determines appropriate times to mine

cryptocurrency in accordance with a desired performance strategy (for example, profitability thresholds). At the appropriate times, the controller initiates mining, for example, by powering on the miners.

DEFENDANTS WRONGFULLY CLAIM THE BEARBOX TECHNOLOGY AS THEIR OWN

32. In May 2019, Storms attended the Fidelity FCAT Mining Summit in Boston, Massachusetts on behalf of BearBox to promote the BearBox Technology and seek potential customers for his revolutionary system.

33. While at the conference, Storms met Defendant McNamara. Defendant McNamara showed immediate interest in the BearBox Technology. Under the rouse of a potential business relationship, McNamara pumped Storms for details about the BearBox Technology over the course of several exchanges, which included conversations, emails, and text messages about the BearBox Technology. Storms took McNamara to dinner where McNamara continued to pump Storms for details about the BearBox Technology. At all times before and during Storms's disclosure of this information, Storms told McNamara that the BearBox Technology was confidential, and Storms relied on McNamara's good faith assurances that he would keep confidential the information he received from Storms about the BearBox Technology.

34. Following the conference, McNamara continued to press Storms for additional details about the BearBox Technology via text messaging and email. Again relying on Defendant McNamara's assurances of confidentiality, Storms provided annotated system diagrams, component specifications, and modeled data sets to mimic real-world Bitcoin and energy prices. Storms included express confidentiality notices in his communications with Defendant McNamara.

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35. After Storms disclosed the BearBox Technology to McNamara, McNamara abruptly ended all communications with Storms.

36. Storms last communicated with McNamara on May 9, 2019 via e-mail, and after sending that message, Storms did not hear from McNamara again.

37. At that time, Storms understood that McNamara was not interested in investing in the BearBox Technology. He had no reason to suspect that McNamara would steal the BearBox Technology and claim it as his own.

38. On information and belief, Defendants filed U.S. provisional patent application No. 62/927,119 on October 28, 2019, naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

39. In addition to falsely claiming to be the inventors of the inventions disclosed in the application, Defendants wrongfully disclosed, without authorization, the confidential BearBox Technology to the United States Patent and Trademark Office.

40. Likewise, on December 4, 2019, Defendants filed U.S. Patent Application Serial No. 16/702,931, once again naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

41. The ’433 Patent issued on March 31, 2020 naming Defendants McNamara and Cline as the sole purported inventors on the face of the patent. A true and correct copy of the ’433 Patent is attached hereto as Exhibit A.

42. The inventions claimed in the ’433 patent encompass the BearBox Technology, yet Defendants falsely identified themselves as the inventors of the claimed inventions, when, in fact, Storms is the sole inventor of the claimed inventions.

43. On information and belief, McNamara and Cline assigned their purported rights in the ’433 patent to Lancium. On information and belief, at all times, Lancium was aware that McNamara and Cline, both officers of Lancium, were not the rightful inventors of the BearBox Technology disclosed in the patent and the inventions claimed in the patent.

44. Defendants McNamara and Cline each submitted signed declarations falsely swearing that they were “an original joint inventor” of the claimed subject matter. A true and correct copy of Defendant McNamara’s and Defendant Cline’s declarations are attached as Exhibit B.

45. On August 14, 2020, Lancium filed a lawsuit in the U.S. District Court for the Western District of Texas against Layer1 Technologies, Inc. (“Layer1”) asserting that Layer1 infringes the ’433 patent. That case is captioned *Lancium LLC v. Layer1 Technologies, Inc.*, Case No. 6:20-cv-739 (W.D. Texas) (the “Layer1 Lawsuit”).

46. As part of the Layer1 Lawsuit, Defendants falsely asserted that McNamara and Cline are the sole inventors of the inventions claimed in the ’433 patent.

47. Plaintiffs became aware of Defendants’ wrongful use of the BearBox Technology on or about August 17, 2020, when they learned about the Layer1 Lawsuit through a press release dated August 14, 2020, posted by Lancium on PRNewswire. That press release is available at the following URL: https://www.prnewswire.com/news-releases/controllable-load-resource-clr-market-leader-lancium-files-patent-infringement-lawsuit-against-layer1-301112687.html.

48. Before seeing the August 14, 2020 press release, Plaintiffs were unaware of Defendants’ wrongful use of the BearBox Technology and was unaware of the ’433 patent.

49. On March 5, 2021, Lancium and Layer1 entered a Stipulation to Dismiss with Prejudice in the Layer1 Lawsuit. According to the stipulation, the parties had entered a Settlement Agreement to resolve the Layer1 Lawsuit.

50. According to a press release issued by Lancium on March 8, 2021, Lancium and Layer 1 "have entered into a mutually beneficial partnership. Layer1 has licensed Lancium's intellectual property and Lancium will provide Smart Response™ software and services to Layer1." The press release is available at the following URL: https://www.prnewswire.com/news-releases/lancium-and-layer1-settle-patent-infringement-suit-301242602.html

51. On information and belief, as part of the Settlement Agreement between Lancium and Layer1 to settle the Layer1 Lawsuit, Lancium received and continues to receive valuable consideration from Layer1, all of which rightly belongs to Plaintiffs, the rightful owners of the inventions claimed in the '433 Patent.

COUNT I
CORRECTION OF INVENTORSHIP FOR THE '433 PATENT: AUSTIN STORMS AS SOLE INVENTOR

52. Plaintiffs incorporate the above paragraphs by reference.

53. Storms is the sole inventor of the subject matter claimed in the '433 Patent.

54. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the '433 patent and the currently listed inventors on the '433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms or BearBox.

55. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the '433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT II
IN THE ALTERNATIVE, CORRECTION OF INVENTORSHIP FOR THE '433 PATENT: AUSTIN STORMS AS JOINT INVENTOR WITH THE CURRENTLY NAMED INVENTORS

56. Plaintiffs incorporates the above paragraphs by reference.

57. In the alternative, Storms is a joint inventor of the subject matter claimed in the '433 Patent and should be added to the individuals currently named as inventors on the '433 Patent.

58. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the '433 patent and the currently listed inventors on the '433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms.

59. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the '433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT III
CONVERSION BY LANCIUM, MCNAMARA, AND CLINE

60. Plaintiffs incorporates the above paragraphs by reference.

61. Austin Storms, in his capacity as founder and President of BearBox, conceived, developed, and reduced to practice the BearBox Technology. Plaintiffs own the BearBox Technology, related know-how, and related intellectual property. Plaintiffs owned this property during all relevant time periods in this suit. Information on the BearBox Technology was provided to Defendants solely for the purposes of evaluation for a potential business relationship and under strict confidentiality obligations.

62. Defendants assumed dominion and control over the BearBox Technology by claiming it as their own in the '433 patent. Through their wrongful conduct in obtaining the '433 Patent and claiming the BearBox Technology as their own, the Defendants have wrongfully obtained the purported ability to exclude Plaintiffs and others from using the BearBox Technology. This constitutes unauthorized and unlawful conversion by Defendants.

63. As a result of Defendants' wrongful actions, Plaintiffs will suffer imminent and irreparable damages in an amount to be proven at trial. In particular, Plaintiffs have been damaged by losing valuable intellectual property from which Plaintiffs would have derived substantial revenue via licensing and/or selling patented products.

COUNT IV
UNJUST ENRICHMENT BY LANCIUM, MCNAMARA, AND CLINE

64. Plaintiffs incorporate the above paragraphs by reference.

65. Plaintiffs conferred a benefit on Defendants by providing them valuable intellectual property about cryptocurrency mining systems and related confidential information and materials under the boundaries of a potential collaboration between BearBox and Lancium.

66. Defendants accepted that cryptocurrency mining intellectual property and, indeed, continuously asked Storms to provide more information and materials, having recognized the benefit that Defendants received by having access to the BearBox Technology.

67. Defendants accepted and retained the BearBox Technology, and used it to their own advantage, at Plaintiffs' expense.

68. Defendants have been and continue to be unjustly enriched by profiting from their wrongful conduct. In particular, Defendants have unlawfully used Plaintiffs' property by asserting inventorship over the BearBox Technology, and deriving an unjust benefit from

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exploiting Storms's cryptocurrency mining inventions. It would be inequitable for Defendants to retain these benefits under these circumstances.

69. Plaintiffs have incurred, and continue to incur, detriment in the form of loss of money and property as a result of Defendants' wrongful use of Plaintiffs' intellectual property, including the right to any patent based on their own intellectual property and any royalties derived from that intellectual property. The intellectual property, including the right to any patents based on Plaintiffs' intellectual property and to any patent documents (including assignment documents), U.S. and foreign, are unique and there is no adequate remedy at law.

70. The harm to Plaintiffs is continuous, substantial, and irreparable.

COUNT V
TRADE SECRET MISAPPROPRIATION UNDER
FEDERAL DEFEND TRADE SECRETS ACT, 18 U.S.C. § 1836

71. Plaintiffs incorporate the above paragraphs by reference.

72. At all relevant times, Plaintiffs and Defendants were engaged in interstate commerce. For example, Plaintiffs and Defendants are engaged in trade and business, developing and testing, among other things, cryptocurrency mining systems and related methods in interstate commerce throughout the United States.

73. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about the BearBox Technology relating to cryptocurrency mining systems and related methods from Plaintiff. The confidential information included detailed technical information about the BearBox Technology. Such information constitutes trade secrets of substantial economic value. This confidential technical information was not known to the public or to other persons who can obtain economic value from its

disclosure or use. This information constituted a trade secret under the Defend Trade Secrets Act, 18 U.S.C. §§ 1836.

74. Defendants knew the technical information they received from Austin Storms about the BearBox Technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, for internal use only, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship. Plaintiffs took reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of collaborators that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its offices and computers.

75. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent constituted a misappropriation of Plaintiffs' trade secrets. Defendants acquired the confidential information under circumstances giving rise to a duty to maintain the secrecy of the trade secret or limit the use of the trade secret.

76. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent was an unauthorized disclosure in breach of Defendants' agreement to maintain the secrecy of this information or otherwise limit its use. As recently as December 4, 2019, Defendants have wrongly sworn that Plaintiffs' confidential technical information is their own by declaring to the United States Patent and Trademark Office that they were the original and joint inventors of the inventions claimed in the '433 patent. Even ignoring that Defendants have improperly claimed this information as their own, through their public filings Defendants have disclosed the confidential technical information without the express or implied consent of

Plaintiffs. The acts of taking Plaintiffs' confidential information, claiming it as Defendants' own, and submitting it in public filings were improper means in breach of a confidential relationship. Further, Defendant McNamara agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.

77. As a result of Defendants' misappropriation of Plaintiffs' trade secrets, Plaintiffs' have suffered and will suffer damages in an amount to be proven at trial including, but not limited to, damages for actual loss caused by the misappropriation of the trade secrets, damages for any unjust enrichment caused by the misappropriation of the trade secrets, and/or damages caused by the misappropriation measured by imposition of liability for a reasonable royalty for the Defendants' unauthorized disclosure or use of the trade secrets.

78. The Defendants willfully and maliciously misappropriated the Plaintiffs' trade secrets, and Plaintiffs are therefore entitled to an award of exemplary damages and an award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(C), (D).

COUNT VI
TRADE SECRET MISAPPROPRIATION UNDER TEXAS CIVIL PRACTICE AND REMEDIES CODE § 134A

79. Plaintiffs incorporate the above paragraphs by reference.

80. At all relevant times, Plaintiffs and Defendants were engaged in trade or commerce within the meaning of Texas Civil Practice and Remedies c. § 134A, the Texas Uniform Trade Secrets Act. For example, Plaintiffs and Defendants are engaged in trade and business, developing and testing, among other things, cryptocurrency mining systems and related methods.

81. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about the BearBox Technology relating to cryptocurrency mining systems and related methods from Plaintiff. The confidential information included detailed technical information about the BearBox Technology. Such information constitutes trade secrets of substantial economic value. This confidential technical information was not known to the public or to other persons who can obtain economic value from its disclosure or use. This information constituted a trade secret.

82. Defendants knew the technical information they received from Austin Storms about the BearBox Technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, for internal use only, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship. Plaintiffs took reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of collaborators that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its offices and computers.

83. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent constituted a misappropriation of Plaintiffs' trade secrets. Defendants acquired the confidential information under circumstances giving rise to a duty to maintain the secrecy of the trade secret or limit the use of the trade secret.

84. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent was an unauthorized disclosure in breach of Defendants' agreement to maintain the secrecy of this information or otherwise limit its use. As recently as December 4, 2019,

Defendants have wrongly sworn that Plaintiffs' confidential technical information is their own by declaring to the United States Patent and Trademark Office that they were the original and joint inventors of the inventions claimed in the '433 patent. Even ignoring that Defendants have improperly claimed this information as their own, through their public filings Defendants have disclosed the confidential technical information without the express or implied consent of Plaintiffs. The acts of taking Plaintiffs' confidential information, claiming it as Defendants' own, and submitting it in public filings were improper means in breach of a confidential relationship. Further, Defendant McNamara agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.

85. As a result of the misappropriation of Plaintiffs' trade secrets and intended immediate use by the Defendants, Plaintiffs' have suffered and will suffer damages in an amount to be proven at trial.

COUNT VII
NEGLIGENT MISREPRESENTATION BY LANCIUM AND MCNAMARA

86. Plaintiffs incorporate the above paragraphs by reference.

87. In connection with the potential work involving cryptocurrency mining systems and related methods, Storms told Defendant McNamara that the cryptocurrency mining systems and related methods were proprietary to Plaintiffs and not to be used or shared outside of Lancium. Defendant McNamara gave his word that he would abide by this confidentiality. On information and belief, Defendant McNamara agreed to keep the BearBox Technology confidential despite later recklessly incorporating the BearBox Technology into his own patent applications and swearing, as recently as December 4, 2019, that he is an inventor of the

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BearBox Technology. Storms relied on Defendant McNamara's assurances of confidentiality and continued to share details about the BearBox Technology with Defendants.

88. If Plaintiffs had known that Defendants would secretly incorporate the BearBox Technology into Defendants' own patent applications to claim them as Defendants' intellectual property, Plaintiffs would not have continued working with and sharing intellectual property with Defendants.

89. Plaintiffs suffered a pecuniary loss based on this reliance including the loss of potential patent rights, and the costs of Plaintiffs' know-how converted under the guise of a potential business relationship.

JURY DEMAND

90. Under Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiffs respectfully demand a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, BearBox respectfully requests the following relief:

A. An order that the Director of the United States Patent and Trademark Office correct the inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

B. Alternatively, an order that Defendants sign the requisite documents to correct inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

C. A declaration that Austin Storms is the sole inventor, or, in the alternative, is a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

D. A preliminary and a permanent injunction enjoining Defendants Lancium, McNamara, and Cline from asserting that McNamara or Cline are inventors of the '433 Patent in violation of the United States federal patent laws;

E. An order that Defendants immediately transfer to Plaintiffs all right, title, and interest in all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of Plaintiffs' intellectual property;

F. An order for a constructive trust over all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of Plaintiffs' intellectual property;

G. Financial relief including damages, consequential damages, disgorgement of Defendants' ill-gotten profits, Defendants' unjust enrichment, restitution, reasonable royalty damages, lost profits damages, reliance damages, and/or all other appropriate financial relief, all in an amount to be determined at trial, with interest;

H. An award of the amount by which Defendants have been unjustly enriched by their actions set forth in this Complaint and their purported ownership of patents covering Plaintiffs' intellectual property;

I. An award of exemplary, enhanced, and/or punitive damages as permitted by law, including under 18 U.S.C. § 1836(b)(3)(C) and Texas Business and Commerce Code § 17E;

J. A finding that this is an exceptional case warranting imposition of attorney fees against Defendants and an award to Plaintiffs of its reasonable costs and attorney fees incurred in bringing this action pursuant to 35 U.S.C. § 285;

K. An award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(D); and

L. An award of such further relief at law or in equity, such as preliminary and/or permanent injunctive relief, as the Court deems just and proper.

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Dated: April 14, 2021

EXHIBIT A

US010608433B1

(12) **United States Patent**
McNamara et al.

(10) **Patent No.: US 10,608,433 B1**
(45) **Date of Patent: Mar. 31, 2020**

(54) **METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT**

(71) Applicant: **Lancium LLC**, Houston, TX (US)

(72) Inventors: **Michael T. McNamara**, Newport Beach, CA (US); **Raymond E. Cline, Jr.**, Houston, TX (US)

(73) Assignee: **Lancium LLC**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/702,931**

(22) Filed: **Dec. 4, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/927,119, filed on Oct. 28, 2019.

(51) **Int. Cl.**
H02J 3/14 (2006.01)
H02J 3/00 (2006.01)
G06F 1/3203 (2019.01)

(52) **U.S. Cl.**
CPC ***H02J 3/14*** (2013.01); ***G06F 1/3203*** (2013.01); ***H02J 3/008*** (2013.01)

(58) **Field of Classification Search**
CPC H02J 3/14; H02J 3/008; G06F 1/3203
See application file for complete search history.

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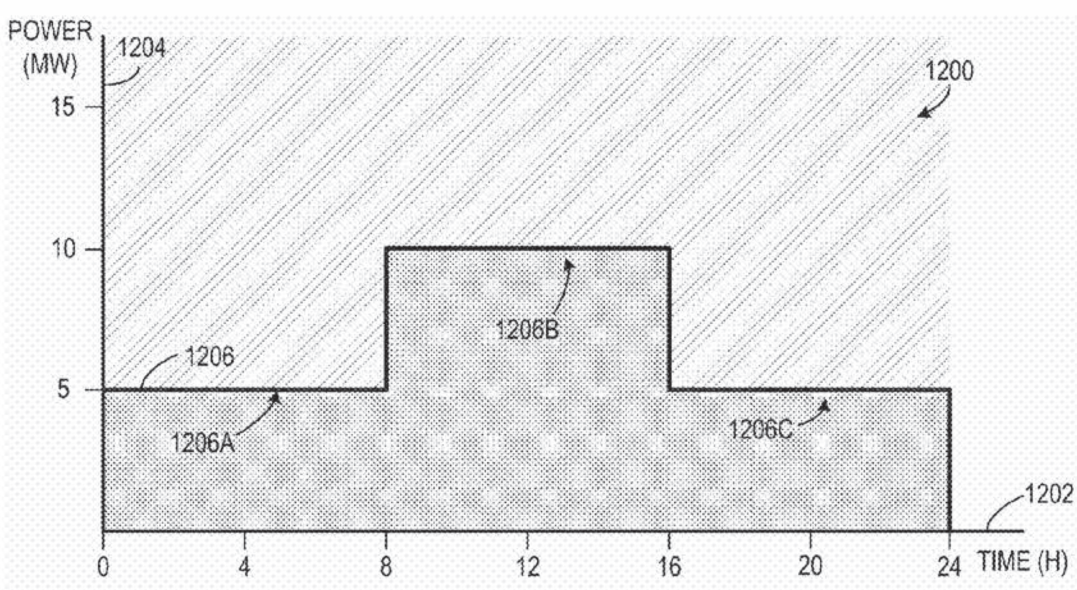
Primary Examiner — Christopher E. Everett
(74) *Attorney, Agent, or Firm* — McDonnell Boehnen Hulbert & Berghoff LLP

(57) **ABSTRACT**

Examples relate to adjusting load power consumption based on a power option agreement. A computing system may receive power option data that is based on a power option agreement and specify minimum power thresholds associated with time intervals. The computing system may determine a performance strategy for a load (e.g., set of computing systems) based on a combination of the power option data and one or more monitored conditions. The performance strategy may specify a power consumption target for the load for each time interval such that each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The computing system may provide instructions the set of computing systems to perform one or more computational operations based on the performance strategy.

20 Claims, 16 Drawing Sheets



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2013/0006401	A1	1/2013	Shan	
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2013/0227139	A1	8/2013	Suffling	
2013/0306276	A1	11/2013	Duchesneau	
2014/0137468	A1	5/2014	Ching	
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2015/0155712	A1	6/2015	Mondal	
2015/0229227	A1	8/2015	Aeloiza et al.	
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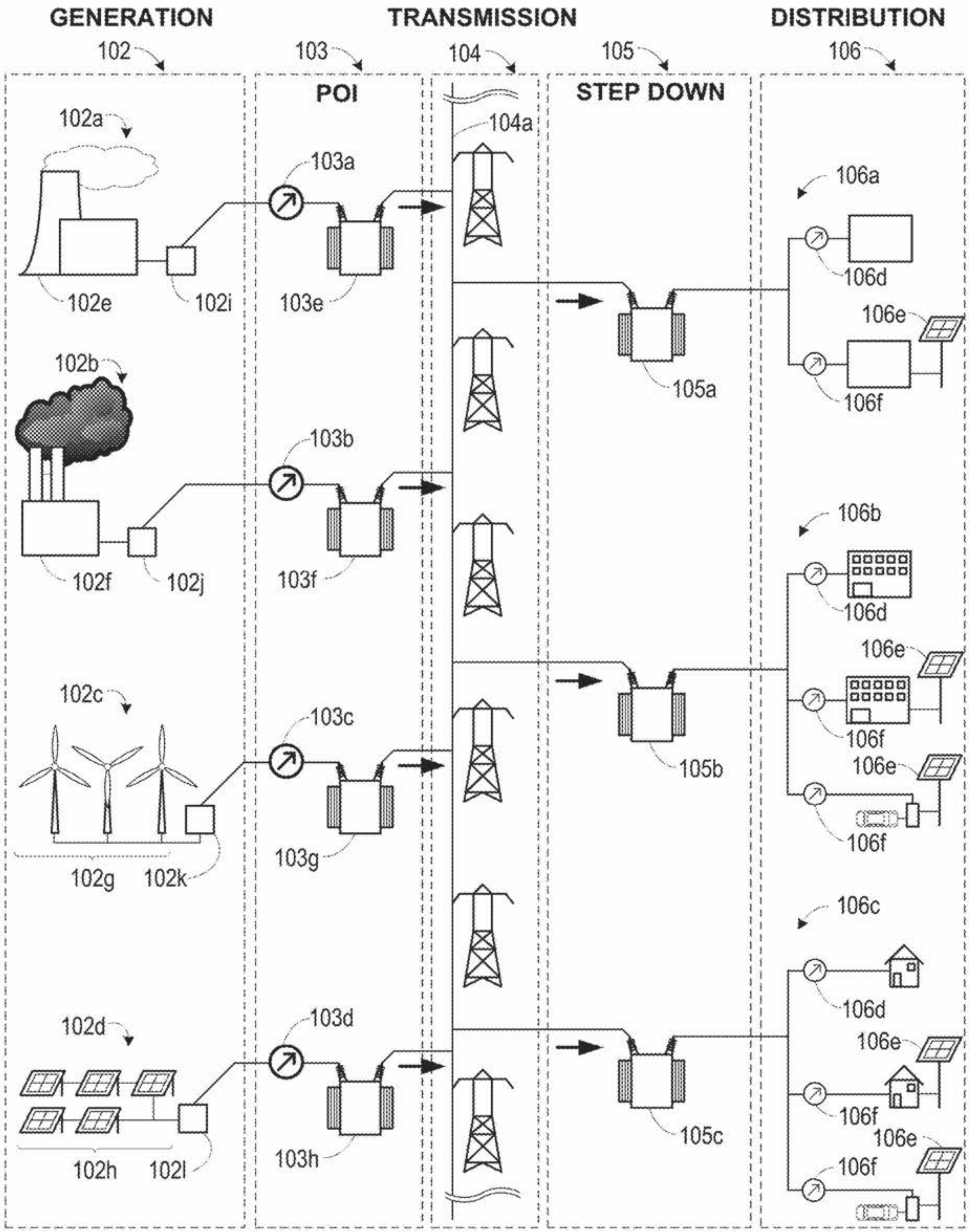

PRIOR ART
FIGURE 1

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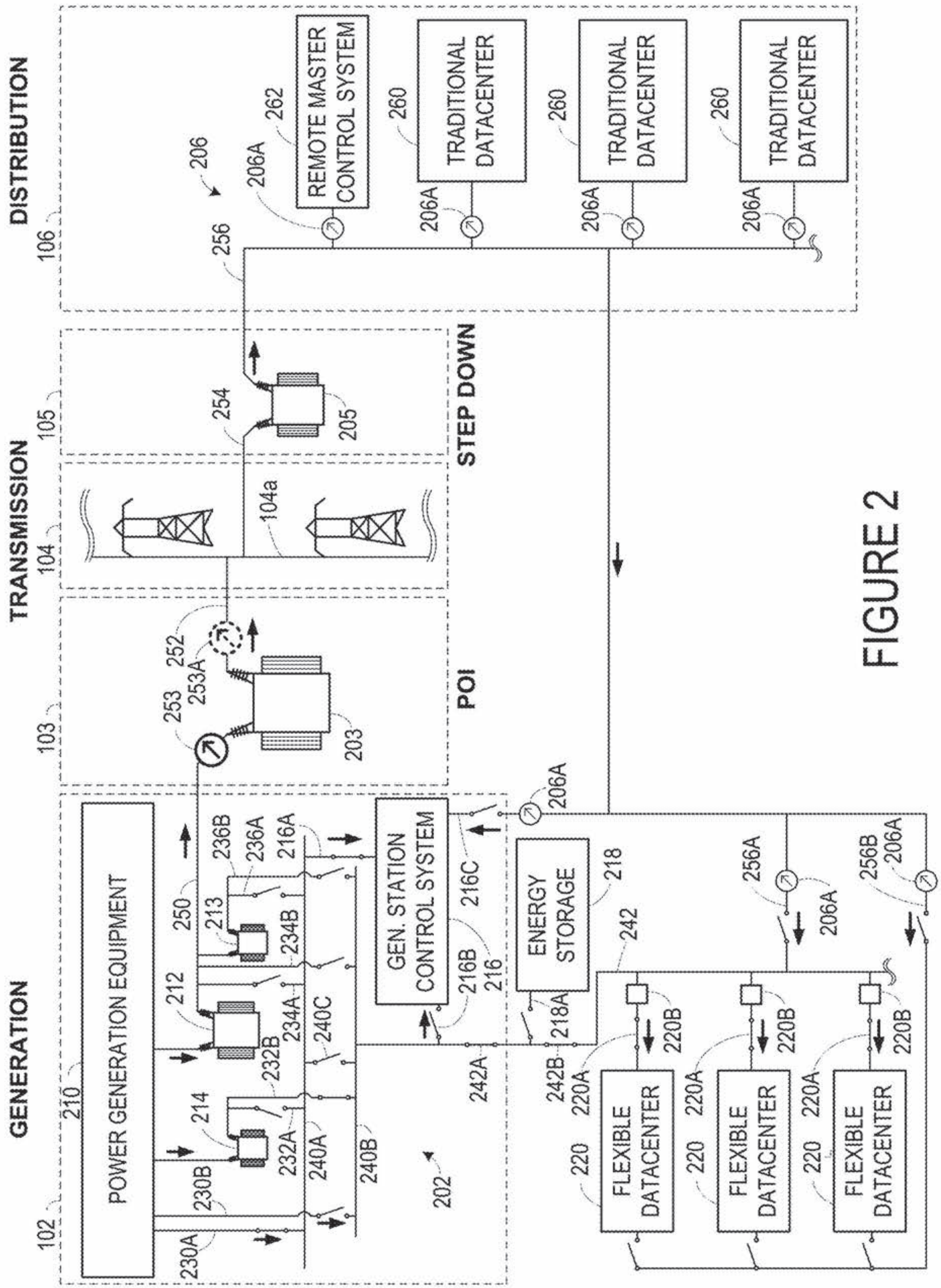

FIGURE 2

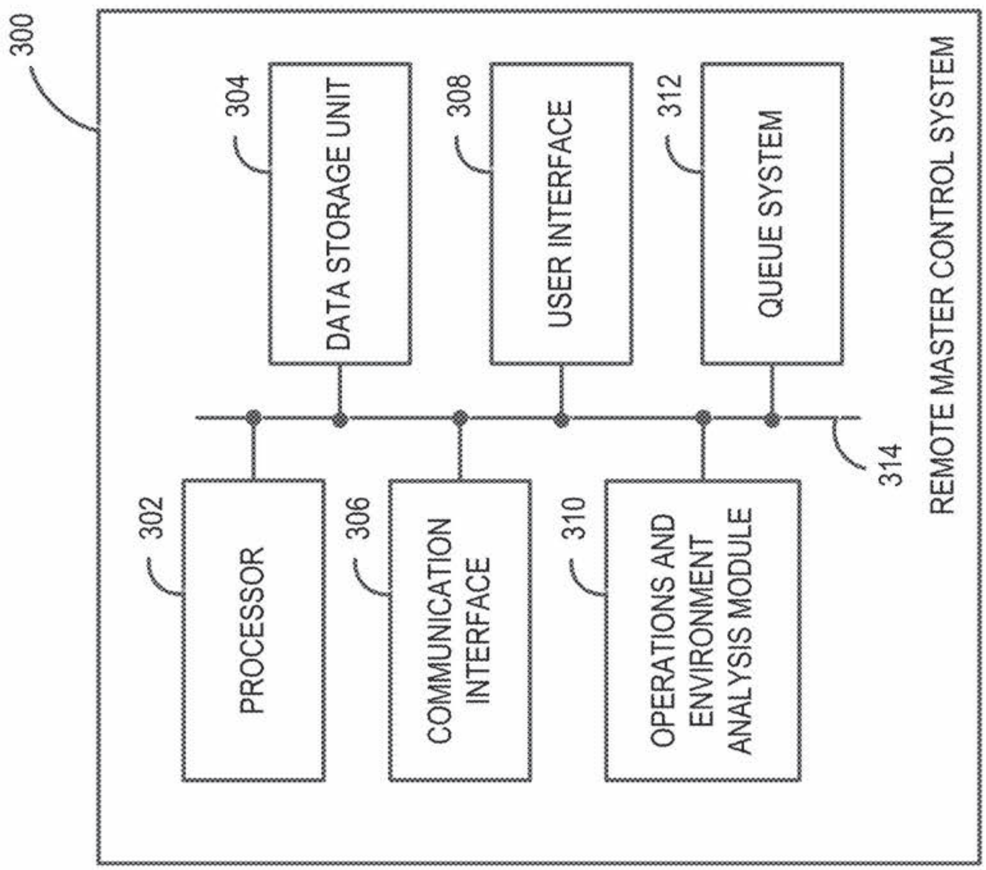
300
304
DATA STORAGE UNIT
308
USER INTERFACE
312
QUEUE SYSTEM
302
PROCESSOR
306
COMMUNICATION INTERFACE
310
OPERATIONS AND ENVIRONMENT ANALYSIS MODULE
314
REMOTE MASTER CONTROL SYSTEM

FIGURE 3

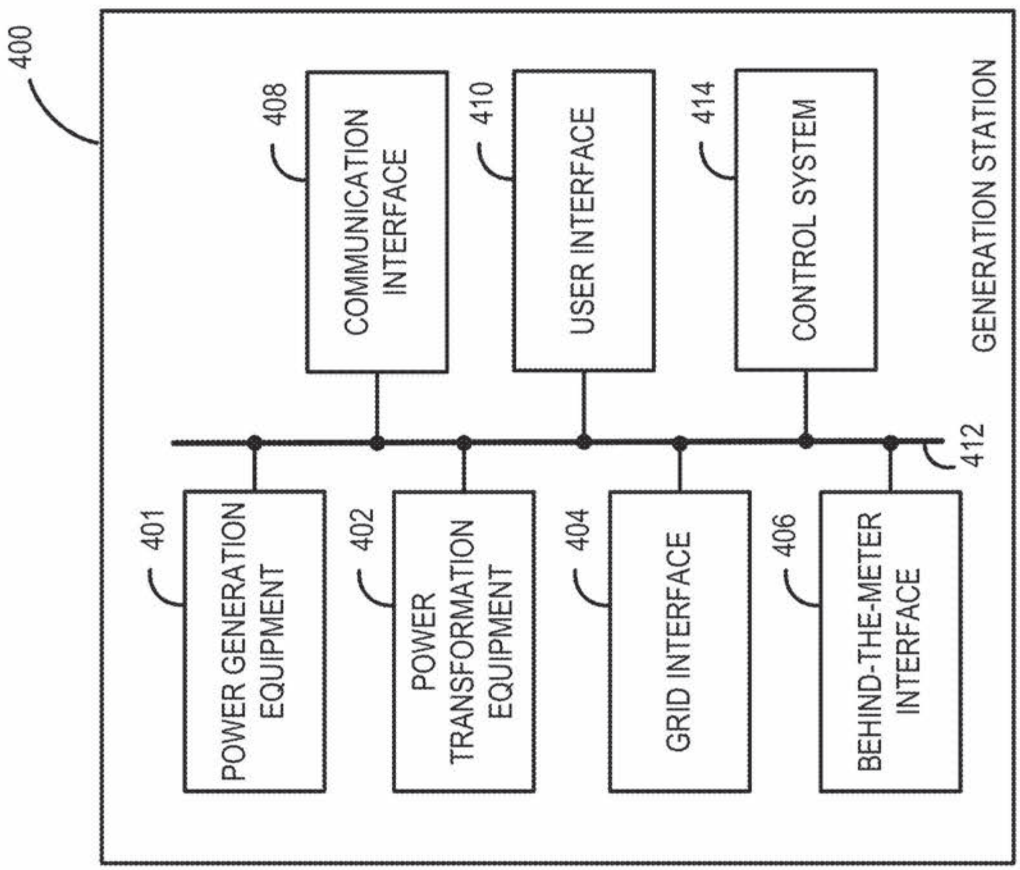
400
GENERATION STATION
408
COMMUNICATION INTERFACE
410
USER INTERFACE
414
CONTROL SYSTEM
412
401
POWER GENERATION EQUIPMENT
402
POWER TRANSFORMATION EQUIPMENT
404
GRID INTERFACE
406
BEHIND-THE-METER INTERFACE

FIGURE 4

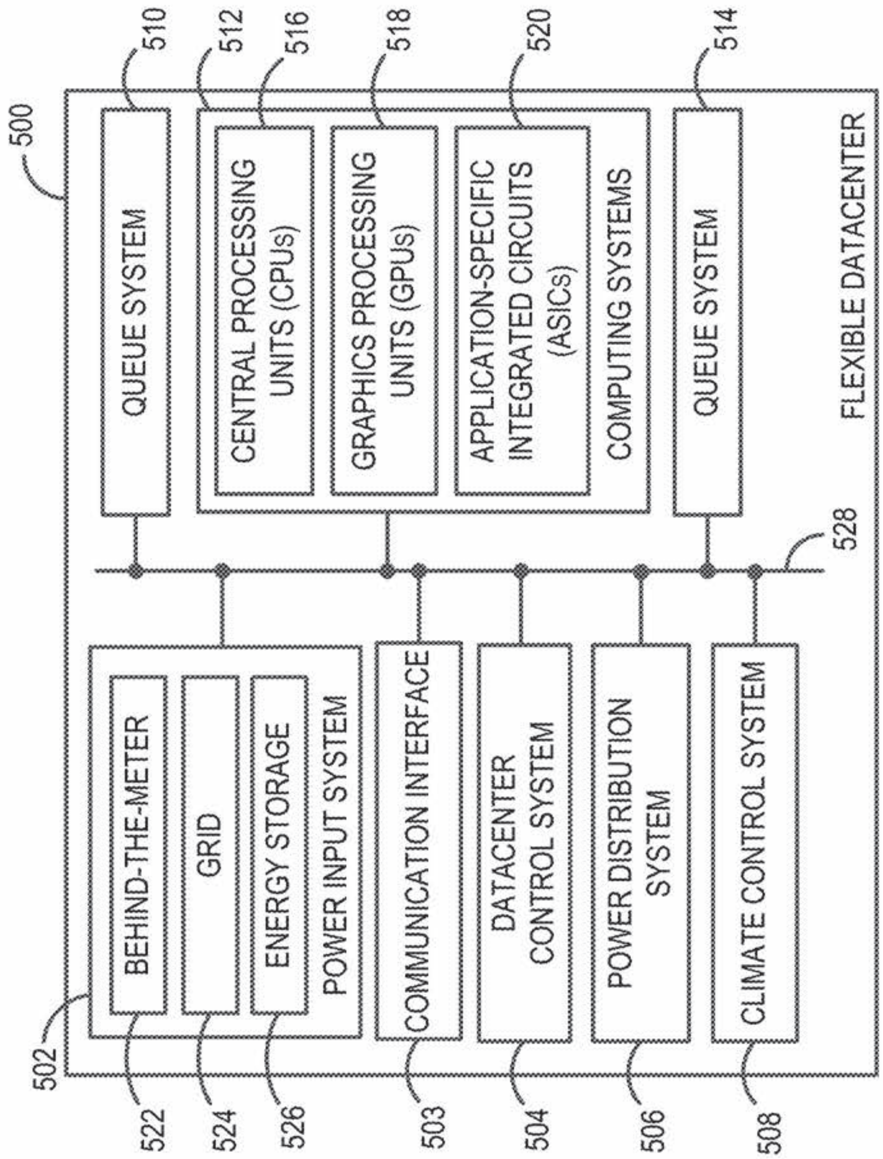
500
FLEXIBLE DATACENTER
510
QUEUE SYSTEM
512
516
CENTRAL PROCESSING UNITS (CPUs)
518
GRAPHICS PROCESSING UNITS (GPUs)
520
APPLICATION-SPECIFIC INTEGRATED CIRCUITS (ASICs)
COMPUTING SYSTEMS
514
QUEUE SYSTEM
528
502
522
BEHIND-THE-METER
524
GRID
526
ENERGY STORAGE
POWER INPUT SYSTEM
503
COMMUNICATION INTERFACE
504
DATACENTER CONTROL SYSTEM
506
POWER DISTRIBUTION SYSTEM
508
CLIMATE CONTROL SYSTEM

FIGURE 5

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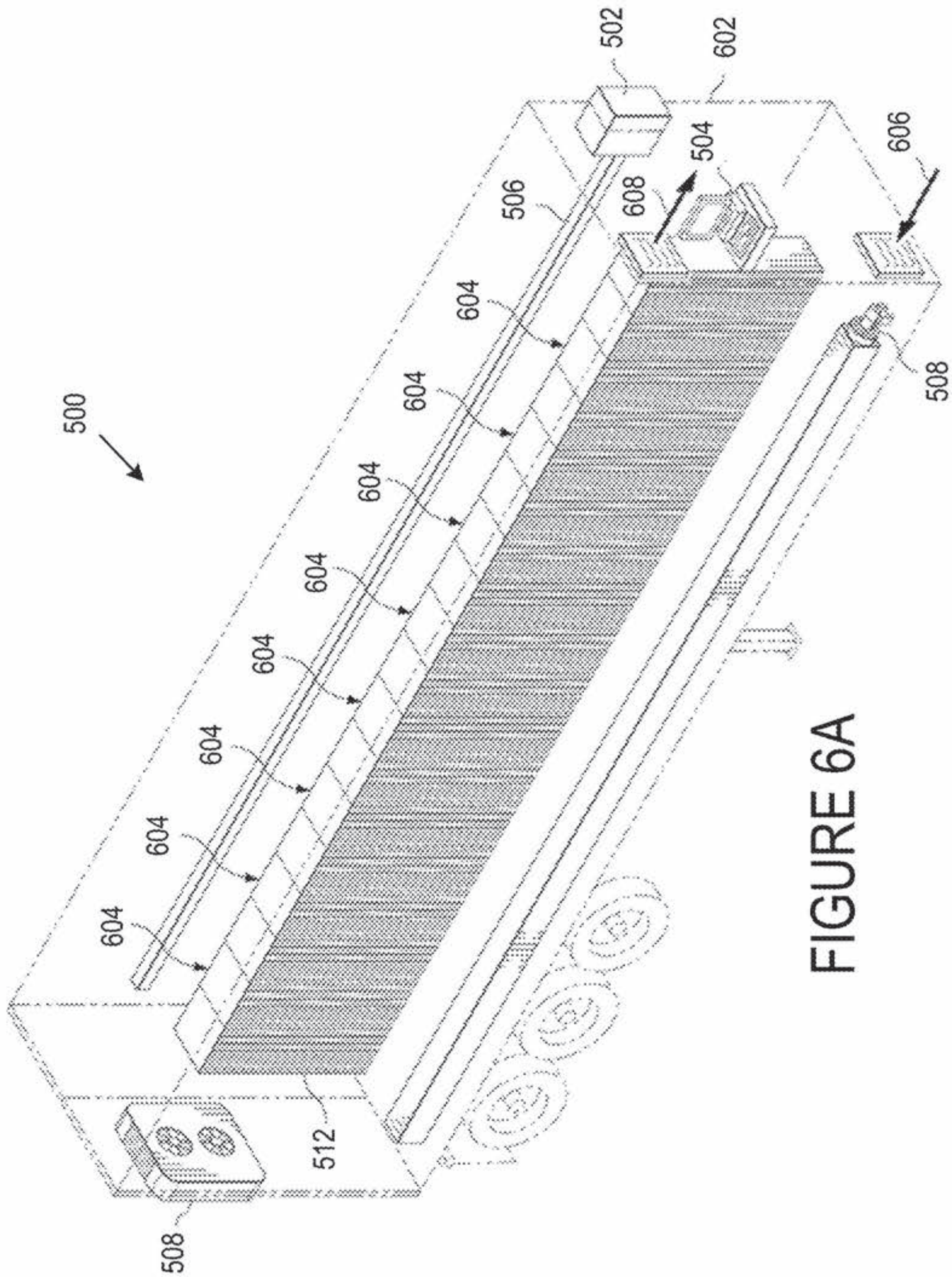

FIGURE 6A

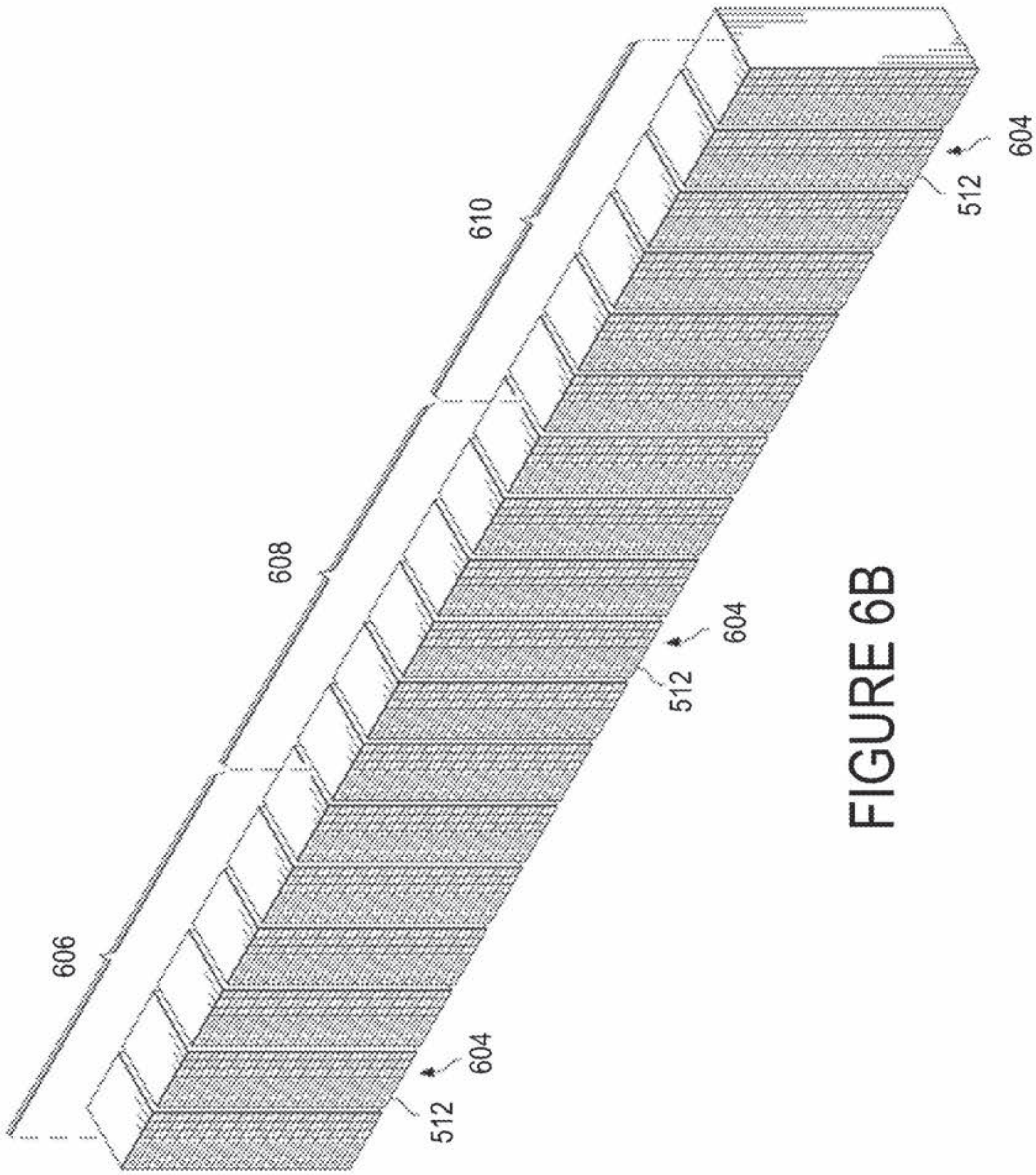

FIGURE 6B

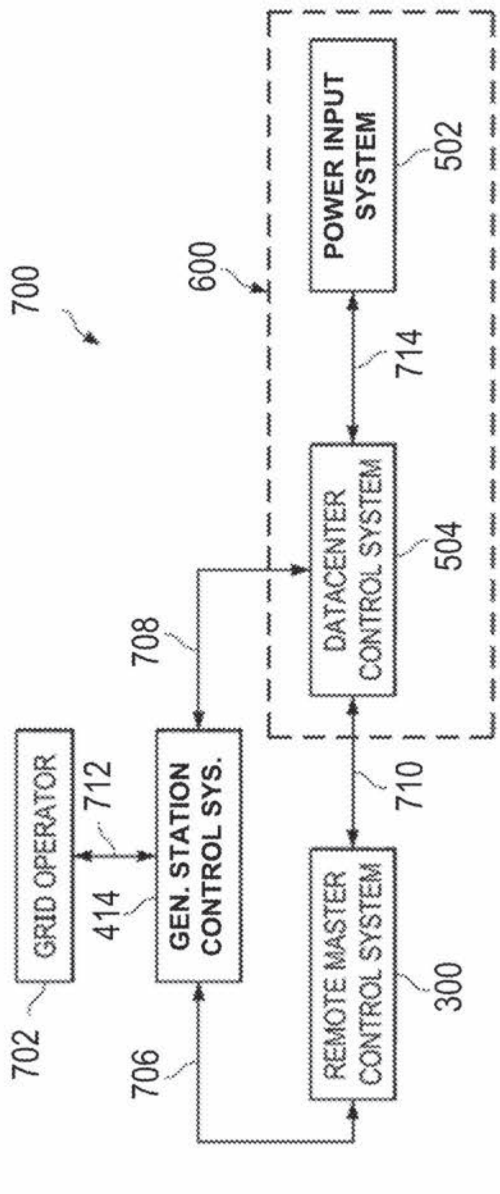
700
600
POWER INPUT SYSTEM
502
714
DATACENTER CONTROL SYSTEM
504
708
GRID OPERATOR
712
GEN. STATION CONTROL SYS.
414
702
706
710
REMOTE MASTER CONTROL SYSTEM
300

FIGURE 7

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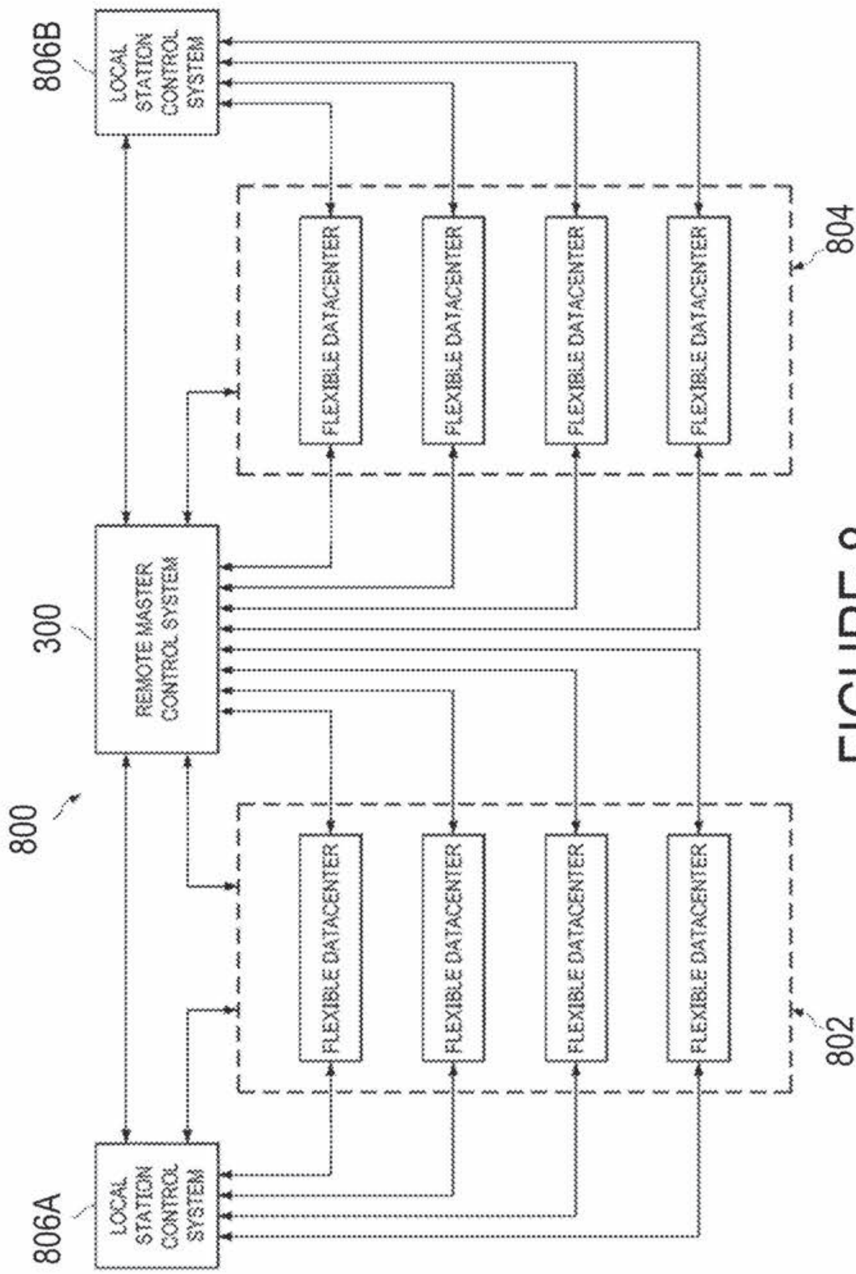


FIGURE 8

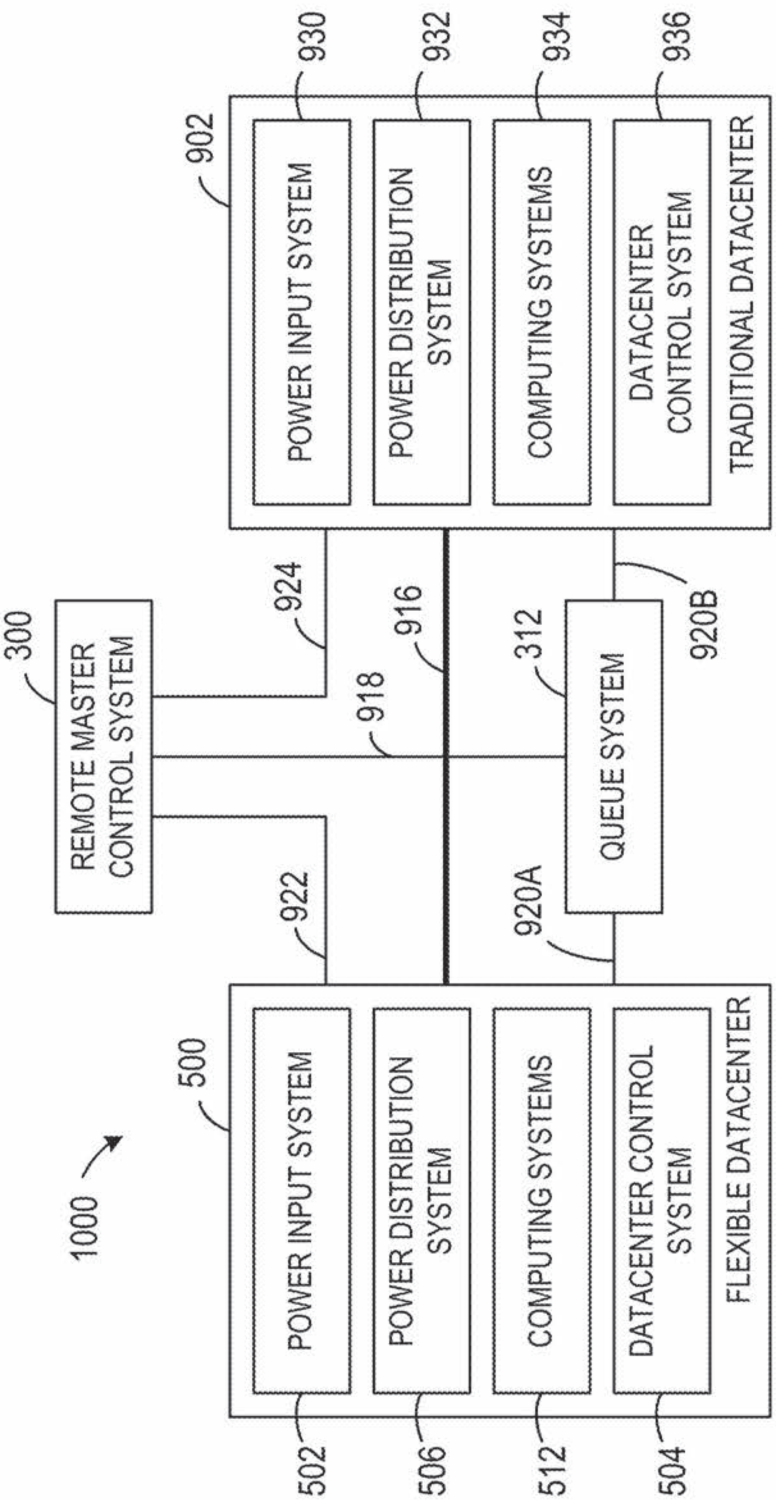

1000
500
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
FLEXIBLE DATACENTER
502
506
512
504
300
REMOTE MASTER CONTROL SYSTEM
922
924
916
918
312
QUEUE SYSTEM
920A
920B
902
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
TRADITIONAL DATACENTER
930
932
934
936

FIGURE 9

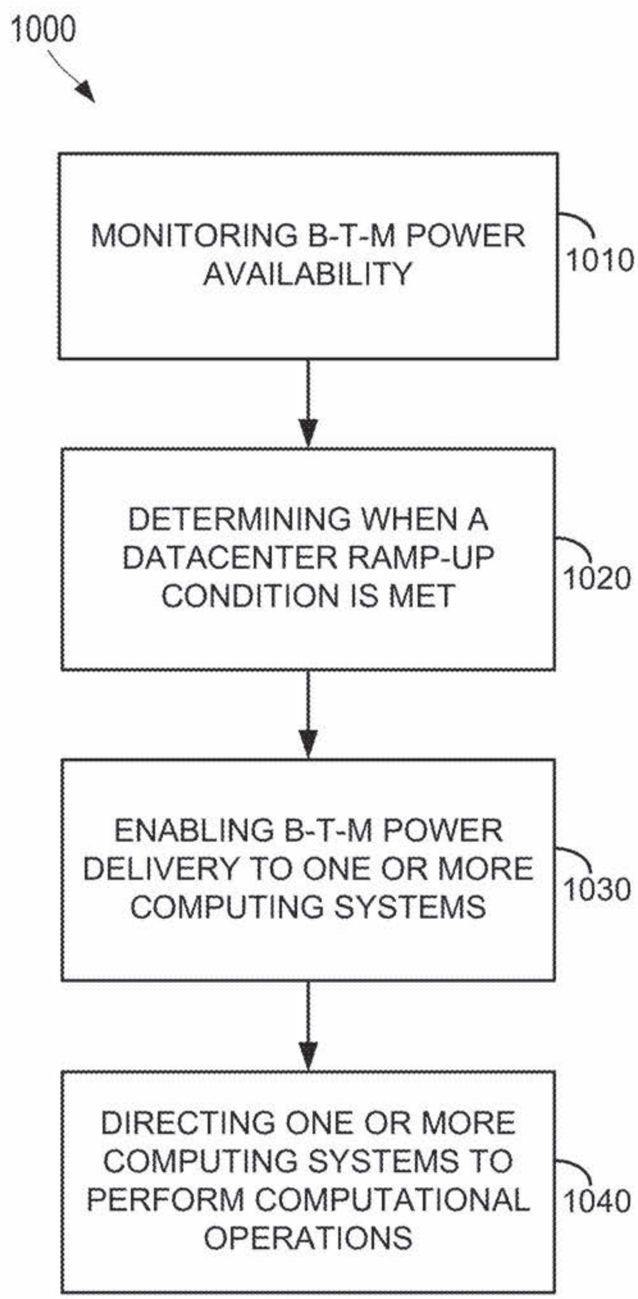

1000
MONITORING B-T-M POWER AVAILABILITY
1010
DETERMINING WHEN A DATACENTER RAMP-UP CONDITION IS MET
1020
ENABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1030
DIRECTING ONE OR MORE COMPUTING SYSTEMS TO PERFORM COMPUTATIONAL OPERATIONS
1040

FIGURE 10A

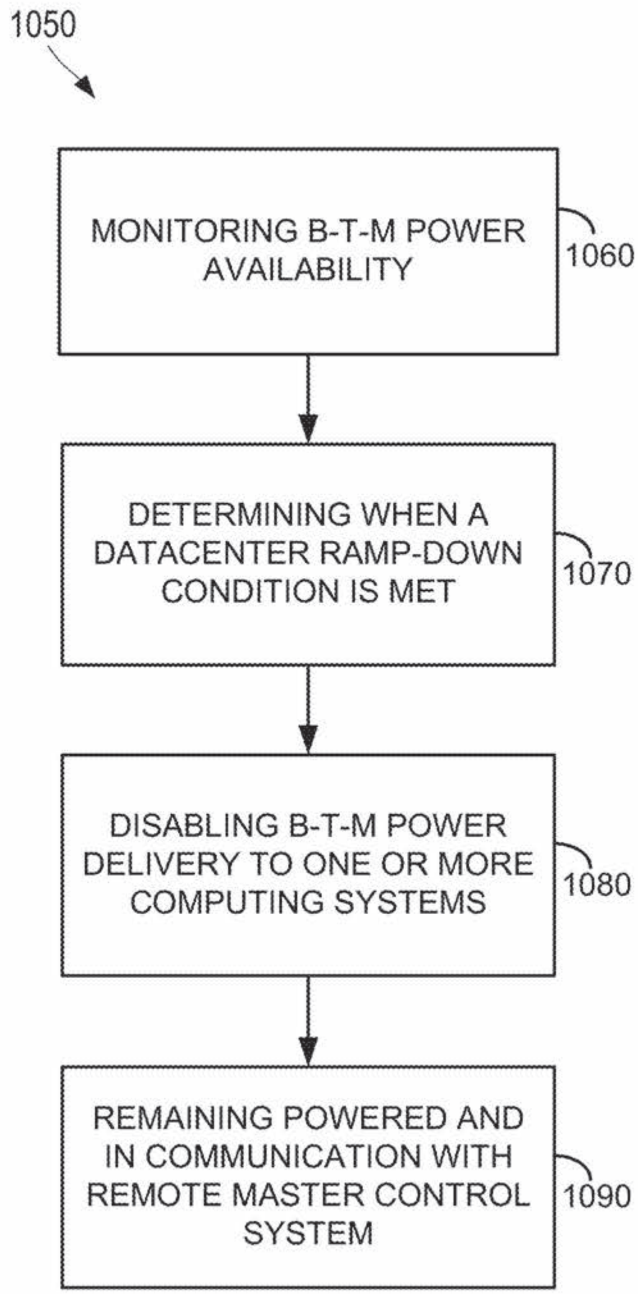
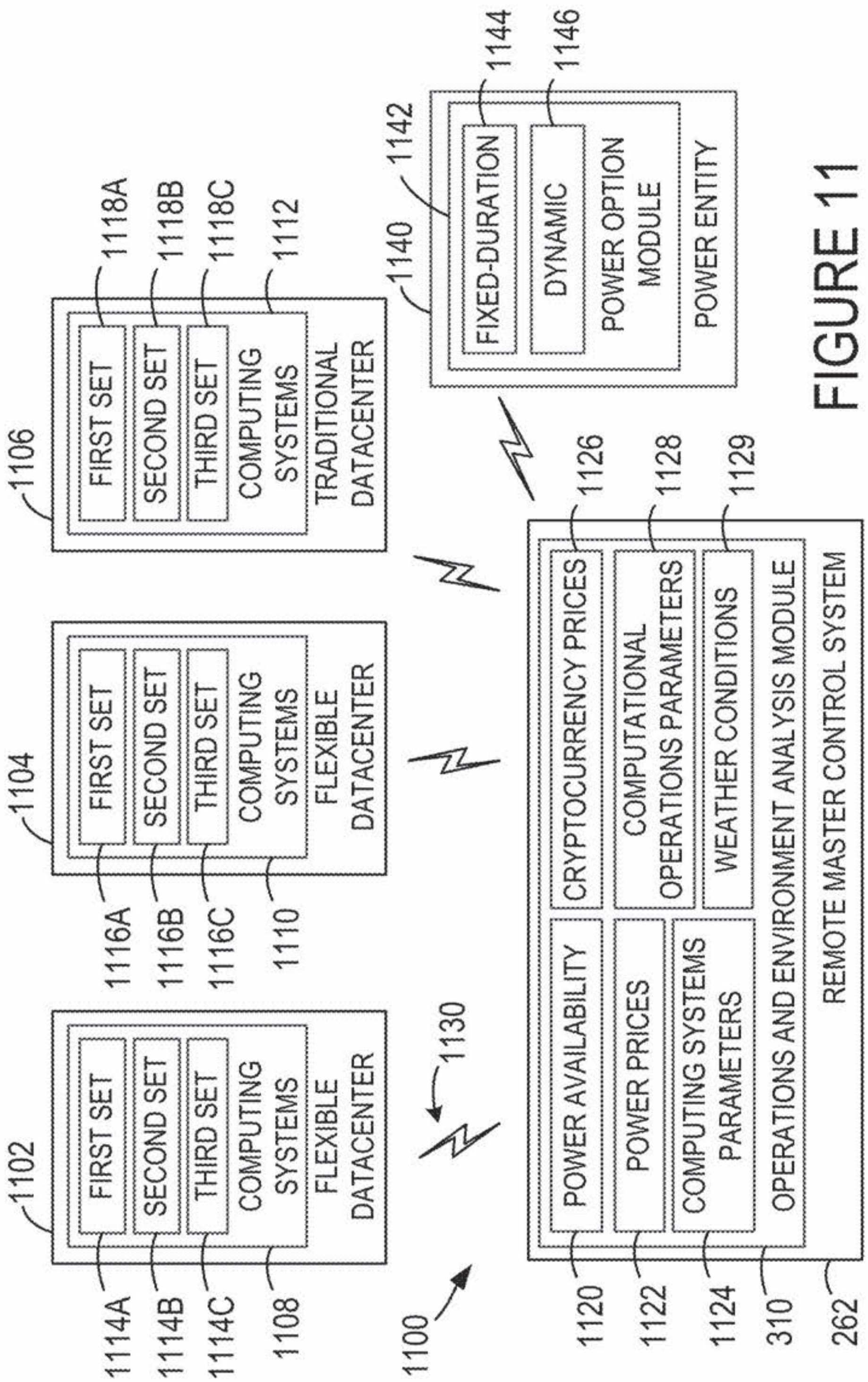

1050
MONITORING B-T-M POWER AVAILABILITY
1060
DETERMINING WHEN A DATACENTER RAMP-DOWN CONDITION IS MET
1070
DISABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1080
REMAINING POWERED AND IN COMMUNICATION WITH REMOTE MASTER CONTROL SYSTEM
1090

FIGURE 10B



1102
FIRST SET
SECOND SET
THIRD SET
COMPUTING SYSTEMS
FLEXIBLE DATACENTER
1114A
1114B
1114C
1108
1104
1116A
1116B
1116C
1110
1106
TRADITIONAL DATACENTER
1118A
1118B
1118C
1112
1100
1130
1140
1142
1144
1146
FIXED-DURATION
DYNAMIC
POWER OPTION MODULE
POWER ENTITY
POWER AVAILABILITY
POWER PRICES
COMPUTING SYSTEMS PARAMETERS
CRYPTOCURRENCY PRICES
COMPUTATIONAL OPERATIONS PARAMETERS
WEATHER CONDITIONS
OPERATIONS AND ENVIRONMENT ANALYSIS MODULE
REMOTE MASTER CONTROL SYSTEM
1120
1122
1124
310
262
1126
1128
1129

FIGURE 11

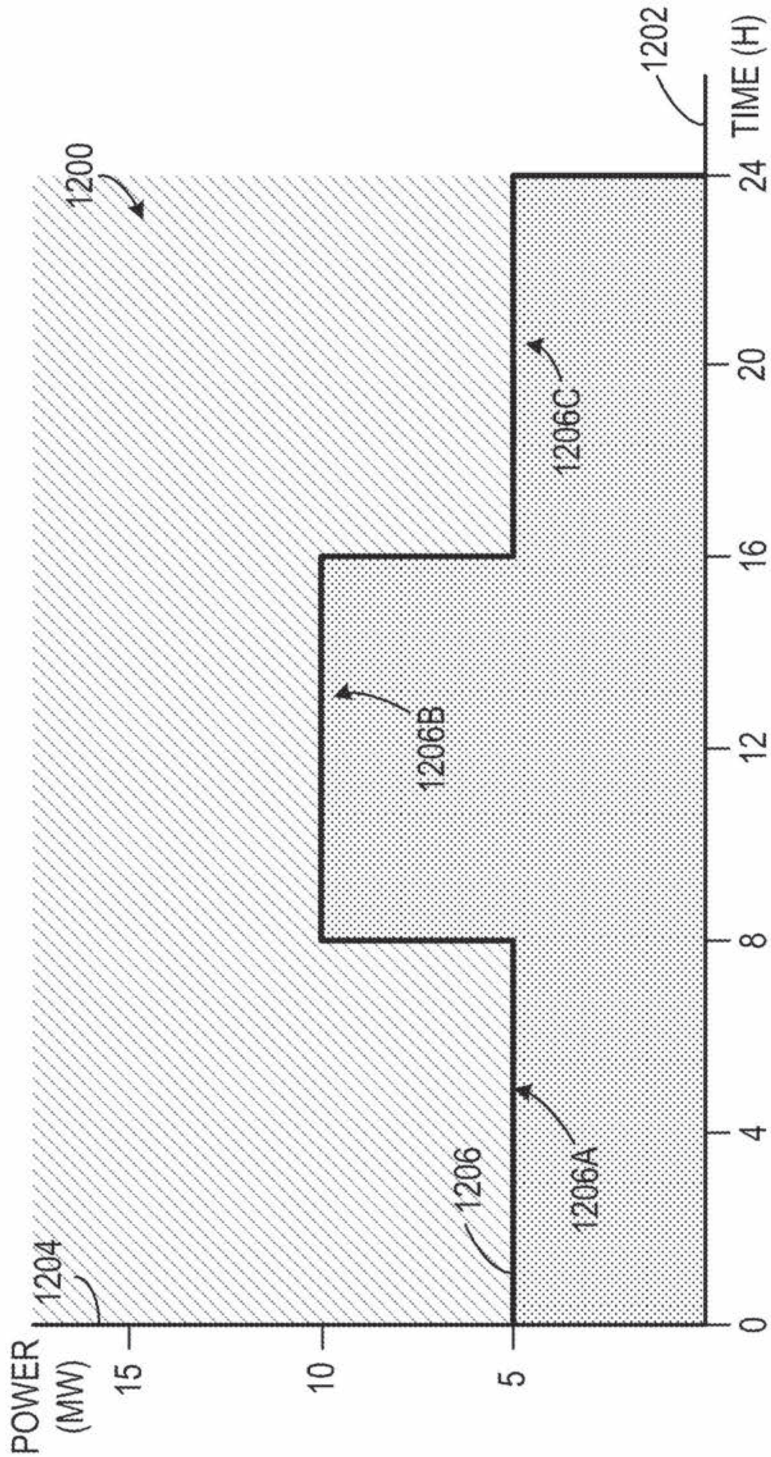

POWER (MW)
15
10
5
0
4
8
12
16
20
24
TIME (H)
1200
1202
1204
1206
1206A
1206B
1206C

FIGURE 12

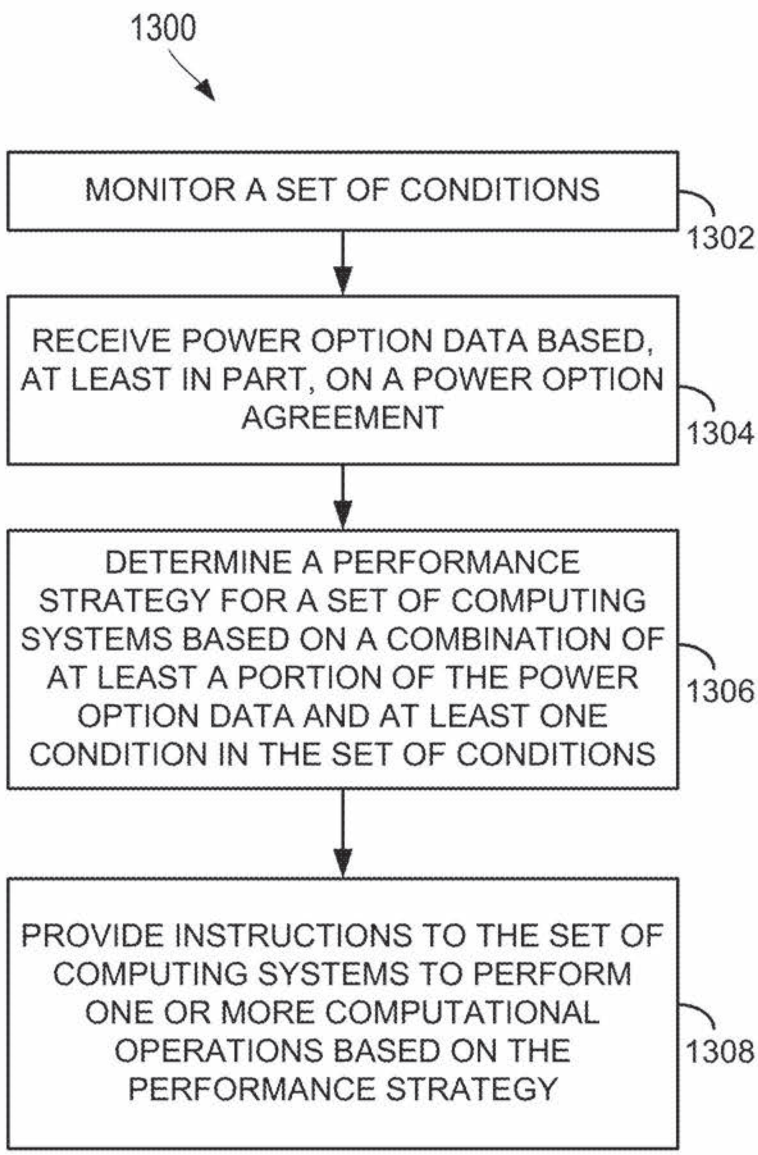

1300
MONITOR A SET OF CONDITIONS
1302
RECEIVE POWER OPTION DATA BASED, AT LEAST IN PART, ON A POWER OPTION AGREEMENT
1304
DETERMINE A PERFORMANCE STRATEGY FOR A SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE POWER OPTION DATA AND AT LEAST ONE CONDITION IN THE SET OF CONDITIONS
1306
PROVIDE INSTRUCTIONS TO THE SET OF COMPUTING SYSTEMS TO PERFORM ONE OR MORE COMPUTATIONAL OPERATIONS BASED ON THE PERFORMANCE STRATEGY
1308

FIGURE 13

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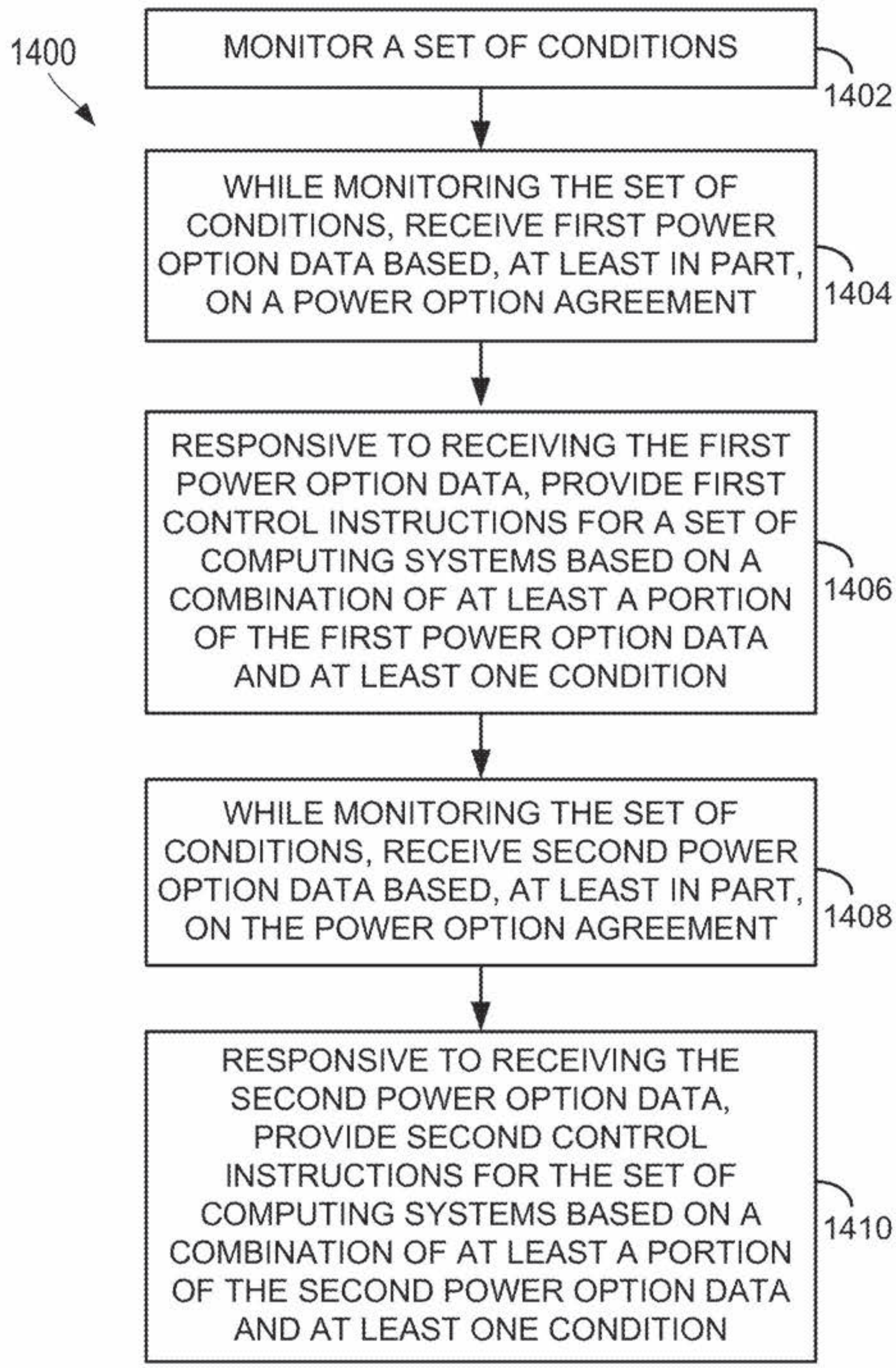

FIGURE 14

METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Patent Application No. 62/927,119, filed Oct. 28, 2019, the entire contents of which are herein incorporated by reference.

FIELD

This specification relates to power consumption adjustments when using grid power and/or intermittent behind-the-meter power.

BACKGROUND

"Electrical grid" or "grid," as used herein, refers to a Wide Area Synchronous Grid (also known as an Interconnection), and is a regional scale or greater electric power grid that that operates at a synchronized frequency and is electrically tied together during normal system conditions. An electrical grid delivers electricity from generation stations to consumers. An electrical grid includes: (i) generation stations that produce electrical power at large scales for delivery through the grid, (ii) high voltage transmission lines that carry that power from the generation stations to demand centers, and (iii) distribution networks carry that power to individual customers.

FIG. **1** illustrates a typical electrical grid, such as a North American Interconnection or the synchronous grid of Continental Europe (formerly known as the UCTE grid). The electrical grid of FIG. **1** can be described with respect to the various segments that make up the grid.

A generation segment **102** includes one or more generation stations that produce utility-scale electricity (typically >50 MW), such as a nuclear plant **102***a*, a coal plant **102***b*, a wind power station (i.e., wind farm) **102***c*, and/or a photovoltaic power station (i.e., a solar farm) **102***d*. Generation stations are differentiated from building-mounted and other decentralized or local wind or solar power applications because they supply power at the utility level and scale (>50 MW), rather than to a local user or users. The primary purpose of generation stations is to produce power for distribution through the grid, and in exchange for payment for the supplied electricity. Each of the generation stations **102***a-d* includes power generation equipment **102***e-h*, respectively, typically capable of supply utility-scale power (>50 MW). For example, the power generation equipment **102***g* at wind power station **102***c* includes wind turbines, and the power generation equipment **102***h* at photovoltaic power station **102***d* includes photovoltaic panels.

Each of the generation stations **102***a-d* may further include station electrical equipment **102***i*-**1** respectively. Station electrical equipment **102***i*-**1** are each illustrated in FIG. **1** as distinct elements for simplified illustrative purposes only and may, alternatively or additionally, be distributed throughout the power generation equipment, **102***e-h*, respectively. For example, at wind power station **102***c*, each wind turbine may include transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each wind turbine may be collected by distribution lines along strings of wind turbines and move through

collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the wind power station **102***c*. Similarly, at photovoltaic power station **102***d*, individual photovoltaic panels and/or arrays of photovoltaic panels may include inverters, transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each photovoltaic panel and/or array may be collected by distribution lines along the photovoltaic panels and move through collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the photovoltaic power station **102***d*.

Each generation station **102***a-d* may produce AC or DC electrical current which is then typically stepped up to a higher AC voltage before leaving the respective generation station. For example, wind turbines may typically produce AC electrical energy at 600V to 700V, which may then be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***c*. As another example, photovoltaic arrays may produce DC voltage at 600V to 900V, which is then inverted to AC voltage and may be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***d*.

Upon exiting the generation segment **102**, electrical power generated at generation stations **102***a-d* passes through a respective Point of Interconnection ("POI") **103** between a generation station (e.g., **102***a-d*) and the rest of the grid. A respective POI **103** represents the point of connection between a generation station's (e.g. **102***a-d*) equipment and a transmission system (e.g., transmission segment **104**) associated with electrical grid. In some cases, at the POI **103**, generated power from generation stations **102***a-d* may be stepped up at transformer systems **103***e-h* to high voltage scales suitable for long-distance transmission along transmission lines **104***a*. Typically, the generated electrical energy leaving the POI **103** will be at 115 kV AC or above, but in some cases it may be as low as, for example, 69 kV for shorter distance transmissions along transmission lines **104***a*. Each of transformer systems **103***e-h* may be a single transformer or may be multiple transformers operating in parallel or series and may be co-located or located in geographically distinct locations. Each of the transformer systems **103***e-h* may include substations and other links between the generation stations **102***a-d* and the transmission lines **104***a*.

A key aspect of the POI **103** is that this is where generation-side metering occurs. One or more utility-scale generation-side meters **103***a-d* (e.g., settlement meters) are located at settlement metering points at the respective POI **103** for each generation station **102***a-d*. The utility-scale generation-side meters **103***a-d* measure power supplied from generation stations **102***a-d* into the transmission segment **104** for eventual distribution throughout the grid.

For electricity consumption, the price consumers pay for power distributed through electric power grids is typically composed of, among other costs, Generation, Administration, and Transmission & Distribution ("T&D") costs. T&D costs represent a significant portion of the overall price paid by consumers for electricity. These costs include capital costs (land, equipment, substations, wire, etc.), costs associated with electrical transmission losses, and operation and maintenance costs.

For utility-scale electricity supply, operators of generation stations (e.g., **102***a-d*) are paid a variable market price for the amount of power the operator generates and provides to the grid, which is typically determined via a power purchase agreement (PPA) between the generation station operator and a grid operator. The amount of power the generation station operator generates and provides to the grid is measured by utility-scale generation-side meters (e.g., **103***a-d*) at settlement metering points. As illustrated in FIG. **1**, the utility-scale generation-side meters **103***a-d* are shown on a low side of the transformer systems **103***e-h*), but they may alternatively be located within the transformer systems **103***e-h* or on the high side of the transformer systems **103***e-h*. A key aspect of a utility-scale generation-side meter is that it is able to meter the power supplied from a specific generation station into the grid. As a result, the grid operator can use that information to calculate and process payments for power supplied from the generation station to the grid. That price paid for the power supplied from the generation station is then subject to T&D costs, as well as other costs, in order to determine the price paid by consumers.

After passing through the utility-scale generation-side meters in the POI **103**, the power originally generated at the generation stations **102***a-d* is transmitted onto and along the transmission lines **104***a* in the transmission segment **104**. Typically, the electrical energy is transmitted as AC at 115 kV+ or above, though it may be as low as 69 kV for short transmission distances. In some cases, the transmission segment **104** may include further power conversions to aid in efficiency or stability. For example, transmission segment **104** may include high-voltage DC ("HVDC") portions (along with conversion equipment) to aid in frequency synchronization across portions of the transmission segment **104**. As another example, transmission segment **104** may include transformers to step AC voltage up and then back down to aid in long distance transmission (e.g., 230 kV, 500 kV, 765 kV, etc.).

Power generated at the generation stations **104***a-d* is ultimately destined for use by consumers connected to the grid. Once the energy has been transmitted along the transmission segment **104**, the voltage will be stepped down by transformer systems **105***a-c* in the step down segment **105** so that it can move into the distribution segment **106**.

In the distribution segment **106**, distribution networks **106***a-c* take power that has been stepped down from the transmission lines **104***a* and distribute it to local customers, such as local sub-grids (illustrated at **106***a*), industrial customers, including large EV charging networks (illustrated at **106***b*), and/or residential and retail customers, including individual EV charging stations (illustrated at **106***c*). Customer meters **106***d*, **106***f* measure the power used by each of the grid-connected customers in distribution networks **106***a-c*. Customer meters **106***d* are typically load meters that are unidirectional and measure power use. Some of the local customers in the distribution networks **106***a-d* may have local wind or solar power systems **106***e* owned by the customer. As discussed above, these local customer power systems **106***e* are decentralized and supply power directly to the customer(s). Customers with decentralized wind or solar power systems **106***e* may have customer meters **106***f* that are bidirectional or net-metering meters that can track when the local customer power systems **106***e* produce power in excess of the customer's use, thereby allowing the utility to provide a credit to the customer's monthly electricity bill. Customer meters **106***d*, **106***f* differ from utility-scale generation-side meters (e.g., settlement meters) in at least the following characteristics: design (electro-mechanical or electronic vs current transformer), scale (typically less than 1600 amps vs. typically greater than 50 MW; typically less than 600V vs. typically greater than 14 kV), primary function (use vs. supply metering), economic purpose (credit against use vs payment for power), and location (in a distribution network at point of use vs. at a settlement metering point at a Point of Interconnection between a generation station and a transmission line).

To maintain stability of the grid, the grid operator strives to maintain a balance between the amount of power entering the grid from generation stations (e.g., **102***a-d*) and the amount of grid power used by loads (e.g., customers in the distribution segment **106**). In order to maintain grid stability and manage congestion, grid operators may take steps to reduce the supply of power arriving from generation stations (e.g., **102***a-d*) when necessary (e.g., curtailment). Particularly, grid operators may decrease the market price paid for generated power to dis-incentivize generation stations (e.g., **102***a-d*) from generating and supplying power to the grid. In some cases, the market price may even go negative such that generation station operators must pay for power they allow into the grid. In addition, some situations may arise where grid operators explicitly direct a generation station (e.g., **102***a-d*) to reduce or stop the amount of power the station is supplying to the grid.

Power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and operational directives resulting in reduced or discontinued generation all can have disparate effects on renewal energy generators and can occur multiple times in a day and last for indeterminate periods of time. Curtailment, in particular, is particularly problematic.

According to the National Renewable Energy Laboratory's Technical Report TP-6A20-60983 (March 2014):

> [C]urtailment [is] a reduction in the output of a generator from what it could otherwise produce given available resources (e.g., wind or sunlight), typically on an involuntary basis. Curtailments can result when operators or utilities command wind and solar generators to reduce output to minimize transmission congestion or otherwise manage the system or achieve the optimal mix of resources. Curtailment of wind and solar resources typically occurs because of transmission congestion or lack of transmission access, but it can also occur for reasons such as excess generation during low load periods that could cause baseload generators to reach minimum generation thresholds, because of voltage or interconnection issues, or to maintain frequency requirements, particularly for small, isolated grids. Curtailment is one among many tools to maintain system energy balance, which can also include grid capacity, hydropower and thermal generation, demand response, storage, and institutional changes. Deciding which method to use is primarily a matter of economics and operational practice.
>
> "Curtailment" today does not necessarily mean what it did in the early 2000s. Two separate changes in the electric sector have shaped curtailment practices since that time: the utility-scale deployment of wind power, which has no fuel cost, and the evolution of wholesale power markets. These simultaneous changes have led to new operational challenges but have also expanded the array of market-based tools for addressing them.
>
> Practices vary significantly by region and market design. In places with centrally-organized wholesale power markets and experience with wind power, manual wind energy curtailment processes are increasingly being

replaced by transparent offer-based market mechanisms that base dispatch on economics. Market protocols that dispatch generation based on economics can also result in renewable energy plants generating less than what they could potentially produce with available wind or sunlight. This is often referred to by grid operators by other terms, such as "downward dispatch." In places served primarily by vertically integrated utilities, power purchase agreements (PPAs) between the utility and the wind developer increasingly contain financial provisions for curtailment contingencies.

Some reductions in output are determined by how a wind operator values dispatch versus non-dispatch. Other curtailments of wind are determined by the grid operator in response to potential reliability events. Still other curtailments result from overdevelopment of wind power in transmission-constrained areas.

Dispatch below maximum output (curtailment) can be more of an issue for wind and solar generators than it is for fossil generation units because of differences in their cost structures. The economics of wind and solar generation depend on the ability to generate electricity whenever there is sufficient sunlight or wind to power their facilities.

Because wind and solar generators have substantial capital costs but no fuel costs (i.e., minimal variable costs), maximizing output improves their ability to recover capital costs. In contrast, fossil generators have higher variable costs, such as fuel costs. Avoiding these costs can, depending on the economics of a specific generator, to some degree reduce the financial impact of curtailment, especially if the generator's capital costs are included in a utility's rate base.

Curtailment may result in available energy being wasted because solar and wind operators have zero variable cost (which may not be true to the same extent for fossil generation units which can simply reduce the amount of fuel that is being used). With wind generation, in particular, it may also take some time for a wind farm to become fully operational following curtailment. As such, until the time that the wind farm is fully operational, the wind farm may not be operating with optimum efficiency and/or may not be able to provide power to the grid.

SUMMARY

In an example, a system includes a set of computing systems. The set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and, while monitoring the set of conditions, receive first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The control system is further configured to provide first control instructions for the set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions responsive to receiving the first power option data. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The control system is also configured to, while monitoring the set of conditions, receive second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. Responsive to receiving the second power option data, the control system is configured to provide second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and wherein the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In another example, a method involves monitoring, at a computing system, a set of conditions, and while monitoring the set of conditions, receiving first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The method further involves, responsive to receiving the first power option data, providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The method further involves, while monitoring the set of conditions, receiving second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. The method also involves, responsive to receiving the second power option data, providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In yet another example, a system is provided. The system includes a set of computing systems, where the set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and receive power option data based, at least in part, on a power option agreement. The power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, where each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals. The control system is further configured to, responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, where each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The control system is also configured to provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

In a further example, non-transitory computer-readable medium is described that is configured to store instructions,

that when executed by a computing system, causes the computing system to perform operations consistent with the method steps described above.

Other aspects of the present invention will be apparent from the following description and claims.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** shows a typical electrical grid.

FIG. **2** shows a behind-the-meter arrangement with optional grid power, including one or more flexible datacenters, according to one or more example embodiments.

FIG. **3** shows a block diagram of a remote master control system, according to one or more example embodiments.

FIG. **4** a block diagram of a generation station, according to one or more example embodiments.

FIG. **5** shows a block diagram of a flexible datacenter, according to one or more example embodiments.

FIG. **6**A shows a structural arrangement of a flexible datacenter, according to one or more example embodiments.

FIG. **6**B shows a set of computing systems arranged in a straight configuration, according to one or more example embodiments.

FIG. **7** shows a control distribution system for a flexible datacenter, according to one or more example embodiments.

FIG. **8** shows a control distribution system for a fleet of flexible datacenters, according to one or more example embodiments.

FIG. **9** shows a queue distribution system for a traditional datacenter and a flexible datacenter, according to one or more example embodiments.

FIG. **10**A shows a method of dynamic power consumption at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **10**B shows a method of dynamic power delivery at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **11** shows a block diagram of a system for implementing power consumption adjustments based on a power option agreement, according to one or more embodiments.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments.

FIG. **13** shows a method for implementing power consumption adjustments based on a fixed-duration power option agreement, according to one or more embodiments.

FIG. **14** shows a method for implementing power consumption adjustments based on a dynamic power option agreement, according to one or more embodiments.

DETAILED DESCRIPTION

Disclosed examples will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all of the disclosed examples are shown. Different examples may be described and should not be construed as limited to the examples set forth herein.

As discussed above, the market price paid to generation stations for supplying power to the grid often fluctuates due to various factors, including the need to maintain grid stability and based on current demand and usage by connected loads in distribution networks. Due to these factors, situations can arise where generation stations are offered substantially lower prices to deter an over-supply of power to the grid. Although these situations typically exist temporarily, generation stations are sometimes forced to either sell power to the grid at the much lower prices or adjust

operations to decrease the amount of power generated. Furthermore, some situations may even require generation stations to incur costs in order to offload power to the grid or to shut down generation temporarily.

The volatility in the market price offered for power supplied to the grid can be especially problematic for some types of generation stations. In particular, wind farms and some other types of renewable resource power producers may lack the ability to quickly adjust operations in response to changes in the market price offered for supplying power to the grid. As a result, power generation and management at some generation stations can be inefficient, which can frequently result in power being sold to the grid at low or negative prices. In some situations, a generation station may even opt to halt power generation temporarily to avoid such unfavorable pricing. As such, the time required to halt and to restart the power generation at a generation station can reduce the generation station's ability to take advantage of rising market prices for power supplied to the grid.

Example embodiments provided herein aim to assist generation stations in managing power generation operations and avoid unfavorable power pricing situations like those described above. In particular, example embodiments may involve providing a load that is positioned behind-the-meter ("BTM") and enabling the load to utilize power received behind-the-meter at a generation station in a timely manner. As a general rule of thumb, BTM power is not subject to traditional T&D costs.

For purposes herein, a generation station is considered to be configured for the primary purpose of generating utility-scale power for supply to the electrical grid (e.g., a Wide Area Synchronous Grid or a North American Interconnect).

In one embodiment, equipment located behind-the-meter ("BTM equipment") is equipment that is electrically connected to a generation station's power generation equipment behind (i.e., prior to) the generation station's POI with an electrical grid.

In one embodiment, behind-the-meter power ("BTM power") is electrical power produced by a generation station's power generation equipment and utilized behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM equipment receives power from the generation station, but the power received by the BTM equipment from the generation station has not passed through the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM power is utilized before being metered at the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that supplies power to a grid, and the BTM equipment receives power from the generation station that is not subject to T&D charges, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that supplies power to a grid, and the BTM power is not subject to T&D charges before being used by electrical equipment, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, equipment may be considered behind-the-meter if the BTM equipment receives power generated from the generation station and that received power is not routed through the electrical grid before being delivered to the BTM equipment.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station, and BTM equipment receives that generated power, and that generated power received by the BTM equipment is not routed through the electrical grid before being delivered to the BTM equipment.

For purposes herein, BTM equipment may also be referred to as a behind-the-meter load ("BTM load") when the BTM equipment is actively consuming BTM power.

Beneficially, where BTM power is not subject to traditional T&D costs, a wind farm or other type of generation station can be connected to BTM loads which can allow the generation station to selectively avoid the adverse or less-than optimal cost structure occasionally associated with supplying power to the grid by shunting generated power to the BTM load.

An arrangement that positions and connects a BTM load to a generation station can offer several advantages. In such arrangements, the generation station may selectively choose whether to supply power to the grid or to the BTM load, or both. The operator of a BTM load may pay to utilize BTM power at a cost less than that charged through a consumer meter (e.g., **106***d*, **1060** located at a distribution network (e.g., **106***a*-*c*) receiving power from the grid. The operator of a BTM load may additionally or alternatively charge less than the market rate to consume excess power generated at the generation station during curtailment. As a result, the generation station may direct generated power based on the "best" price that the generation station can receive during a given time frame, and/or the lowest cost the generation station may incur from negative market pricing during curtailment. The "best" price may be the highest price that the generation station may receive for its generated power during a given duration, but can also differ within embodiments and may depend on various factors, such as a prior PPA.

In one example, by having a behind-the-meter option available, a generation station may transition from supplying all generated power to the grid to supplying some or all generated power to one or more BTM loads when the market price paid for power by grid operators drops below a predefined threshold (e.g., the price that the operator of the BTM load is willing to pay the generation station for power). Thus, by having an alternative option for power consumption (i.e., one or more BTM loads), the generation station can selectively utilize the different options to maximize the price received for generated power. In addition, the generation station may also utilize a BTM load to avoid or reduce the economic impact in situations when supplying power to the grid would result in the generation station incurring a net cost.

Providing BTM power to a load can also benefit the BTM load operator. A BTM load may be able to receive and utilize BTM power received from the generation station at a cost that is lower than the cost for power from the grid (e.g., at a customer meter **106***d*, **1060**. This is primarily due to the avoidance (or significant reduction) in T&D costs and the market effects of curtailment. As indicated above, the generation station may be willing to divert generated power to the BTM load rather than supplying the grid due to changing market conditions, or during maintenance periods, or for other non-market conditions. Thus, some situations may arise where the generation station offers power to the BTM load at a price that is substantially lower than the price available on the grid. Furthermore, in some situations, the BTM load may even be able to obtain and utilize BTM power from a generation station at no cost or even at negative pricing since the generation station may rather supply the BTM load with generated power during a given time range instead of paying a higher price for the grid to take the power or modifying operations to decrease power output.

Another example of cost-effective use of BTM power is when the generation station **202** is selling power to the grid at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price the generation station **202** would have to pay to the grid power to offload generation's station **202** generated power. Advantageously, one or more flexible datacenters **220** may take the generated power behind-the-meter, thereby allowing the generation station **202** to produce and obtain the production tax credit, while selling less power to the grid at the negative price.

Another example of cost-effective behind-the-meter power is when the generation station **202** is selling power to the grid at a negative price because the grid is oversupplied and/or the generation station **202** is instructed to stand down and stop producing altogether. A grid operator may select and direct certain generation stations to go offline and stop supplying power to the grid. Advantageously, one or more flexible datacenters may be used to take power behind-the-meter, thereby allowing the generation station **202** to stop supplying power to the grid, but still stay online and make productive use of the power generated.

Another example of beneficial behind-the-meter power use is when the generation station **202** is producing power that is, with reference to the grid, unstable, out of phase, or at the wrong frequency, or the grid is already unstable, out of phase, or at the wrong frequency. A grid operator may select certain generation stations to go either offline and stop producing power, or to take corrective action with respect to the grid power stability, phase, or frequency. Advantageously, one or more flexible datacenters **220** may be used to selectively consume power behind-the-meter, thereby allowing the generation station **202** to stop providing power to the grid and/or provide corrective feedback to the grid.

Another example of beneficial behind-the-meter power use is that cost-effective behind-the-meter power availability may occur when the generation station **202** is starting up or testing. Individual equipment in the power generation equipment **210** may be routinely offline for installation, maintenance, and/or service and the individual units must be tested prior to coming online as part of overall power generation equipment **210**. During such testing or maintenance time, one or more flexible datacenters may be intermittently

powered by the one or more units of the power generation equipment **210** that are offline from the overall power generation equipment **210**.

Another example of beneficial behind-the-meter power use is that datacenter control systems at the flexible datacenters **220** may quickly ramp up and ramp down power consumption by computing systems in the flexible datacenters **220** based on power availability from the generation station **202**. For instance, if the grid requires additional power and signals the demand via a higher local price for power, the generation station **202** can supply the grid with power nearly instantly by having active flexible datacenters **220** quickly ramp down and turn off computing systems (or switch to a stored energy source), thereby reducing an active BTM load.

Another example of beneficial behind-the-meter power use is in new photovoltaic generation stations **202**. For example, it is common to design and build new photovoltaic generation stations with a surplus of power capacity to account for degradation in efficiency of the photovoltaic panels over the life of the generation stations. Excess power availability at the generation station can occur when there is excess local power generation and/or low grid demand. In high incident sunlight situations, a photovoltaic generation station **202** may generate more power than the intended capacity of generation station **202**. In such situations, a photovoltaic generation station **202** may have to take steps to protect its equipment from damage, which may include taking one or more photovoltaic panels offline or shunting their voltage to dummy loads or the ground. Advantageously, one or more flexible datacenters (e.g., the flexible datacenters **220**) may take power behind-the-meter at the Generations Station **202**, thereby allowing the generation station **202** to operate the power generation equipment **210** within operating ranges while the flexible datacenters **220** receive BTM power without transmission or distribution costs.

Thus, for at least the reasons described herein, arrangements that involves providing a BTM load as an alternative option for a generation station to direct its generated power to can serve as a mutually beneficial relationship in which both the generation station and the BTM load can economically benefit. The above-noted examples of beneficial use of BTM power are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as benefits to unutilized BTM power capacity, BTM power pricing, or BTM power consumption.

Within example embodiments described herein, various types of utility-scale power producers may operate as generation stations **202** that are capable of supplying power to one or more loads behind-the-meter. For instance, renewable energy sources (e.g., wind, solar, hydroelectric, wave, water current, tidal), fossil fuel power generation sources (coal, natural gas), and other types of power producers (e.g., nuclear power) may be positioned in an arrangement that enables the intermittent supply of generated power behind-the-meter to one or more BTM loads. One of ordinary skill in the art will recognize that the generation station **202** may vary based on an application or design in accordance with one or more example embodiments.

In addition, the particular arrangement (e.g., connections) between the generation station and one or more BTM loads can vary within examples. In one embodiment, a generation station may be positioned in an arrangement wherein the generation station selectively supplies power to the grid and/or to one or more BTM loads. As such, power cost-analysis and other factors (e.g., predicted weather conditions, contractual obligations, etc.) may be used by the generation station, a BTM load control system, a remote master control system, or some other system or enterprise, to selectively output power to either the grid or to one or more BTM loads in a manner that maximizes revenue to the generation station. In such an arrangement, the generation station may also be able to supply both the grid and one or more BTM loads simultaneously. In some instances, the arrangement may be configured to allow dynamic manipulation of the percentage of the overall generated power that is supplied to each option at a given time. For example, in some time periods, the generation station may supply no power to the BTM load.

In addition, the type of loads that are positioned behind-the-meter can vary within example embodiments. In general, a load that is behind-the-meter may correspond to any type of load capable of receiving and utilizing power behind-the-meter from a generation station. Some examples of loads include, but are not limited to, datacenters and electric vehicle (EV) charging stations.

Preferred BTM loads are loads that can be subject to intermittent power supply because BTM power may be available intermittently. In some instances, the generation station may generate power intermittently. For example, wind power station **102***c* and/or photovoltaic power station **102***d* may only generate power when resource are available or favorable. Additionally or alternatively, BTM power availability at a generation station may only be available intermittently due to power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and/or operational directives from grid operators or generation station operators.

Some example embodiments of BTM loads described herein involve using one or more computing systems to serve as a BTM load at a generation station. In particular, the computing system or computing systems may receive power behind-the-meter from the generation station to perform various computational operations, such as processing or storing information, performing calculations, mining for cryptocurrencies, supporting blockchain ledgers, and/or executing applications, etc.

Multiple computing systems positioned behind-the-meter may operate as part of a "flexible" datacenter that is configured to operate only intermittently and to receive and utilize BTM power to carry out various computational operations similar to a traditional datacenter. In particular, the flexible datacenter may include computing systems and other components (e.g., support infrastructure, a control system) configured to utilize BTM power from one or more generation stations. The flexible datacenter may be configured to use particular load ramping abilities (e.g., quickly increase or decrease power usage) to effectively operate during intermittent periods of time when power is available from a generation station and supplied to the flexible datacenter behind-the-meter, such as during situations when supplying generated power to the grid is not favorable for the generation station.

In some instances, the amount of power consumed by the computing systems at a flexible datacenter can be ramped up and down quickly, and potentially with high granularity (i.e., the load can be changed in small increments if desired). This may be done based on monitored power system conditions or other information analyses as discussed herein. As recited above, this can enable a generation station to avoid negative power market pricing and to respond quickly to grid direc-

tives. And by extension, the flexible datacenter may obtain BTM power at a price lower than the cost for power from the grid.

Various types of computing systems can provide granular power ramping. Preferably, the computing systems can perform computational tasks that are immune to, or not substantially hindered by, frequent interruptions or slow-downs in processing as the computing systems ramp down or up. In some embodiments, a control system may be used to activate or de-activate one or more computing systems in an array of computing systems. For example, the control system may provide control instructions to one or more blockchain miners (e.g., a group of blockchain miners), including instructions for powering on or off, adjusting frequency of computing systems performing operations (e.g., adjusting the processing frequency), adjusting the quantity of operations being performed, and when to operate within a low power mode (if available).

Within examples, a control system may correspond to a specialized computing system or may be a computing system within a datacenter serving in the role of the control system. The location of the control system can vary within examples as well. For instance, the control system may be located at a datacenter or physically separate from the datacenter. In some examples, the control system may be part of a network of control systems that manage computational operations, power consumption, and other aspects of a fleet of datacenters. The fleet of datacenters may include one or more traditional datacenters and/or flexible datacenters.

Some embodiments may involve using one or more control systems to direct time-insensitive (e.g., interruptible) computational tasks to computational hardware, such as central processing units (CPUs) and graphics processing units (GPUs), sited behind the meter, while other hardware is sited in front of the meter (i.e., consuming metered grid power via a customer meter (e.g., **106***d*, **1060**) and possibly remote from the behind-the-meter hardware. As such, parallel computing processes, such as Monte Carlo simulations, batch processing of financial transactions, graphics rendering, machine learning, neural network processing, queued operations, and oil and gas field simulation models, are good candidates for such interruptible computational operations.

FIG. **2** shows a behind-the-meter arrangement with optional grid-power, including one or more flexible datacenters, according to one or more example embodiments. Dark arrows illustrate a typical power delivery direction. Consistent with FIG. **1**, the arrangement illustrates a generation station **202** in the generation segment **102** of a Wide-Area Synchronous Grid. The generation station **202** supplies utility-scale power (typically >50 MW) via a generation power connection **250** to the Point of Interconnection **103** between the generation station **202** and the rest of the grid. Typically, the power supplied on connection **250** may be at 34.5 kV AC, but it may be higher or lower. Depending on the voltage at connection **250** and the voltage at transmission lines **104***a*, a transformer system **203** may step up the power supplied from the generation station **202** to high voltage (e.g., 115 kV+AC) for transmission over connection **252** and onto transmission lines **104***a* of transmission segment **104**. Grid power carried on the transmission segment **104** may be from generation station **202** as well as other generation stations (not shown). Also consistent with FIG. **1**, grid power is consumed at one or more distribution networks, including example distribution network **206**. Grid power may be taken from the transmission lines **104***a* via connector **254** and stepped down to distribution network voltages (e.g., typically 4 kV to 26 kV AC) and sent into the distribution networks, such as distribution network **206** via distribution line **256**. The power on distribution line **256** may be further stepped down (not shown) before entering individual consumer facilities such as a remote master control system **262** and/or traditional datacenters **260** via customer meters **206**A, which may correspond to customer meters **106***d* in FIG. **1**, or customer meters **106***f* in FIG. **1** if the respective consumer facility includes a local customer power system, such as **106***e* (not shown in FIG. **2**).

Consistent with FIG. **1**, power entering the grid from generation station **202** is metered by a utility-scale generation-side meter. A utility-scale generation-side meter **253** is shown on the low side of transformer system **203** and an alternative location is shown as **253**A on the high side of transformer system **203**. Both locations may be considered settlement metering points for the generation station **202** at the POI **103**. Alternatively, a utility-scale generation-side meter for the generation station **202** may be located at another location consistent with the descriptions of such meters provided herein.

Generation station **202** includes power generation equipment **210**, which may include, as examples, wind turbines and/or photovoltaic panels. Power generation equipment **210** may further include other electrical equipment, including but not limited to switches, busses, collectors, inverters, and power unit transformers (e.g., transformers in wind turbines).

As illustrated in FIG. **2**, generation station **202** is configured to connect with BTM equipment which may function as BTM loads. In the illustrated embodiment of FIG. **2**, the BTM equipment includes flexible datacenters **220**. Various configurations to supply BTM power to flexible datacenters **220** within the arrangement of FIG. **2** are described herein.

In one configuration, generated power may travel from the power generation equipment **210** over one or more connectors **230**A, **230**B to one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **230**A, **230**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **230**B is shown with an open switch, and connector **230**A is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used in various embodiments when BTM power is supplied without significant power conversion to BTM loads.

In various configurations, the busses **240**A and **240**B may be separated by an open switch **240**C or combined into a common bus by a closed switch **240**C.

In another configuration, generated power may travel from the power generation equipment **210** to the high side of a local step-down transformer **214**. The generated power may then travel from the low side of the local step-down transformer **214** over one or more connectors **232**A, **232**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **232**A, **232**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **232**A is shown with an open switch, and connector **232**B is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the power generation equipment **210**, but the generated power must be stepped down prior to use at the BTM loads.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of a local step-up transformer **212**. The generated power may

then travel from the high side of the local step-up transformer **212** over one or more connectors **234**A, **234**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **234**A, **234**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **234**A, **234**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of the local step-up transformer **212**. The generated power may then travel from the high side of the local step-up transformer **212** to the high side of local step-down transformer **213**. The generated power may then travel from the low side of the local step-down transformer **213** over one or more connectors **236**A, **236**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **236**A, **2346** may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **236**A, **236**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**, but the power must be stepped down prior to use at the BTM loads.

In one embodiment, power generated at the generation station **202** may be used to power a generation station control system **216** located at the generation station **202**, when power is available. The generation station control system **216** may typically control the operation of the generation station **202**. Generated power used at the generation station control system **216** may be supplied from bus **240**A via connector **216**A and/or from bus **240**B via connector **216**B. Each of the connectors **216**A, **216**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. While the generation station control system **216** can consume BTM power when powered via bus **240**A or bus **240**B, the BTM power taken by generation station control system **216** is insignificant in terms of rendering an economic benefit. Further, the generation station control system **216** is not configured to operate intermittently, as it generally must remain always on. Further still, the generation station control system **216** does not have the ability to quickly ramp a BTM load up or down.

In another embodiment, grid power may alternatively or additionally be used to power the generation station control system **216**. As illustrated here, metered grid power from a distribution network, such as distribution network **206** for simplicity of illustration purposes only, may be used to power generation station control system **216** over connector **216**C. Connector **216**C may be a switched connector so that metered grid power to the generation station control system **216** can be switched on or off as needed. More commonly, metered grid power would be delivered to the generation station control system **216** via a separate distribution network (not shown), and also over a switched connector. Any such grid power delivered to the generation station control system **216** is metered by a customer meter **206**A and subject to T&D costs.

In another embodiment, when power generation equipment **210** is in an idle or off state and not generating power, grid power may backfeed into generation station **202** through POI **103** and such grid power may power the generation station control system **216**.

In some configurations, an energy storage system **218** may be connected to the generation station **202** via connector **218**A, which may be a switched connector. For illustrative purposes only, connector **218**A is shown with an open switch but in some embodiments it may be closed. The energy storage system **218** may be connected to bus **240**A and/or bus **240**B and store energy produced by the power generation equipment **210**. The energy storage system may also be isolated from generation station **202** by switch **242**A. In times of need, such as when the power generation equipment in an idle or off state and not generating power, the energy storage system may feed power to, for example, the flexible datacenters **220**. The energy storage system may also be isolated from the flexible datacenters **220** by switch **242**B.

In a preferred embodiment, as illustrated, power generation equipment **210** supplies BTM power via connector **242** to flexible datacenters **220**. The BTM power used by the flexible datacenters **220** was generated by the generation station **202** and did not pass through the POI **103** or utility-scale generation-side meter **253**, and is not subject to T&D charges. Power received at the flexible datacenters **220** may be received through respective power input connectors **220**A. Each of the respective connectors **220**A may be switched connector that can electrically isolate the respective flexible datacenter **220** from the connector **242**. Power equipment **220**B may be arranged between the flexible datacenters **220** and the connector **242**. The power equipment **220**B may include, but is not limited to, power conditioners, unit transformers, inverters, and isolation equipment. As illustrated, each flexible datacenter **220** may be served by a respective power equipment **220**B. However, in another embodiment, one power equipment **220**B may serve multiple flexible datacenter **220**.

In one embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter and electrically connected to the power generation equipment **210** behind (i.e., prior to) the generation station's POI **103** with the rest of the electrical grid.

In one embodiment, BTM power produced by the power generation equipment **210** is utilized by the flexible datacenters **220** behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter as the flexible datacenters **220** are electrically connected to the generation station **202**, and generation station **202** is subject to metering by utility-scale generation-side meter **253** (or **253**A, or another utility-scale generation-side meter), and the flexible datacenters **220** receive power from the generation station **202**, but the power received by the flexible datacenters **220** from the generation station **202** has not passed through a utility-scale generation-side meter. In this embodiment, the utility-scale generation-side meter **253** (or **253**A) for the generation station **202** is located at the generation station's **202** POI **103**. In another embodiment, the utility-scale generation-side meter for the generation station **202** is at a location other than the POI for the generation station **202**—for example, a substation (not shown) between the generation station **202** and the generation station's POI **103**.

In another embodiment, power from the generation station **202** is supplied to the flexible datacenters **220** as BTM power, where power produced at the generation station **202** is subject to metering by utility-scale generation-side meter

253 (or 253A, or another utility-scale generation-side meter), but the BTM power supplied to the flexible datacenters 220 is utilized before being metered at the utility-scale generation-side meter 253 (or 253A, or another utility-scale generation-side meter). In this embodiment, the utility-scale generation-side meter 253 (or 253A) for the generation station 202 is located at the generation station's 202 POI 103. In another embodiment, the utility-scale generation-side meter for the generation station 202 is at a location other than the POI for the generation station 202—for example, a substation (not shown) between the generation station 202 and the generation station's POI 103.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter as they are electrically connected to the generation station 202 that supplies power to the grid, and the flexible datacenters 220 receive power from the generation station 202 that is not subject to T&D charges, but power otherwise received from the grid that is supplied by the generation station 202 is subject to T&D charges.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 that supplies power to a grid, and the generated power is not subject to T&D charges before being used by flexible datacenters 220, but power otherwise received from the connected grid is subject to T&D charges.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter because they receive power generated from the generation station 202 intended for the grid, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 for distribution to the grid, and the flexible datacenters 220 receive that power, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, metered grid power may alternatively or additionally be used to power one or more of the flexible datacenters 220, or a portion within one or more of the flexible datacenters 220. As illustrated here for simplicity, metered grid power from a distribution network, such as distribution network 206, may be used to power one or more flexible datacenters 220 over connector 256A and/or 256B. Each of connector 256A and/or 256B may be a switched connector so that metered grid power to the flexible datacenters 220 can be switched on or off as needed. More commonly, metered grid power would be delivered to the flexible datacenters 220 via a separate distribution network (not shown), and also over switched connectors. Any such grid power delivered to the flexible datacenters 220 is metered by customer meters 206A and subject to T&D costs. In one embodiment, connector 256B may supply metered grid power to a portion of one or more flexible datacenters 220. For example, connector 256B may supply metered grid power to control and/or communication systems for the flexible datacenters 220 that need constant power and cannot be subject to intermittent BTM power. Connector 242 may supply solely BTM power from the generation station 202 to high power demand computing systems within the flexible datacenters 220, in which case at least a portion of each flexible datacenters 220 so connected is operating as a BTM load. In another embodiment, connector 256A and/or 256B may supply all power used at one or more of the flexible

datacenters 220, in which case each of the flexible datacenters 220 so connected would not be operating as a BTM load.

In another embodiment, when power generation equipment 210 is in an idle or off state and not generating power, grid power may backfeed into generation station 202 through POI 103 and such grid power may power the flexible datacenters 220.

The flexible datacenters 220 are shown in an example arrangement relative to the generation station 202. Particularly, generated power from the generation station 202 may be supplied to the flexible datacenters 220 through a series of connectors and/or busses (e.g., 232B, 240B, 242, 220A). As illustrated, in other embodiments, connectors between the power generation equipment 210 and other components may be switched open or closed, allowing other pathways for power transfer between the power generation equipment 210 and components, including the flexible datacenters 220. Additionally, the connector arrangement shown is illustrative only and other circuit arrangements are contemplated within the scope of supplying BTM power to a BTM load at generation station 202. For example, there may be more or fewer transformers, or one or more of transformers 212, 213, 214 may be transformer systems with multiple steppings and/or may include additional power equipment including but not limited to power conditioners, filters, switches, inverters, and/or AC/DC-DC/AC isolators. As another example, metered grid power connections to flexible datacenters 220 are shown via both 256A and 256B; however, a single connection may connect one or more flexible datacenters 220 (or power equipment 220B) to metered grid power and the one or more flexible datacenters 220 (or power equipment 220B) may include switching apparatus to direct BTM power and/or metered grid power to control systems, communication systems, and/or computing systems as desired.

In some examples, BTM power may arrive at the flexible datacenters 220 in a three-phase AC format. As such, power equipment (e.g., power equipment 220B) at one or more of the flexible datacenters 220 may enable each flexible datacenter 220 to use one or more phases of the power. For instance, the flexible datacenters 220 may utilize power equipment (e.g., power equipment 220B, or alternatively or additionally power equipment that is part of the flexible datacenter 220) to convert BTM power received from the generation station 202 for use at computing systems at each flexible datacenter 220. In other examples, the BTM power may arrive at one or more of the flexible datacenters 220 as DC power. As such, the flexible datacenters 220 may use the DC power to power computing systems. In some such examples, the DC power may be routed through a DC-to-DC converter that is part of power equipment 220B and/or flexibles datacenter 220.

In some configurations, a flexible datacenter 220 may be arranged to only have access to power received behind-the-meter from a generation station 202. In the arrangement of FIG. 2, the flexible datacenters 220 may be arranged only with a connection to the generation station 202 and depend solely on power received behind-the-meter from the generation station 202. Alternatively or additionally, the flexible datacenters 220 may receive power from energy storage system 218.

In some configurations, one or more of the flexible datacenters 220 can be arranged to have connections to multiple sources that are capable of supplying power to a flexible datacenter 220. To illustrate a first example, the flexible datacenters 220 are shown connected to connector 242, which can be connected or disconnected via switches to

the energy storage system **218** via connector **218**A, the generation station **202** via bus **240**B, and grid power via metered connector **256**A. In one embodiment, the flexible datacenters **220** may selectively use power received behind-the-meter from the generation station **202**, stored power supplied by the energy storage system **218**, and/or grid power. For instance, flexible datacenters **220** may use power stored in the energy storage system **218** when costs for using power supplied behind-the-meter from the generation station **202** are disadvantageous. By having access to the energy storage system **218** available, the flexible datacenters **220** may use the stored power and allow the generation station **202** to subsequently refill the energy storage system **218** when cost for power behind-the-meter is low. Alternatively, the flexible datacenters **220** may use power from multiple sources simultaneously to power different components (e.g., a first set and a second set of computing systems). Thus, the flexible datacenters **220** may leverage the multiple connections in a manner that can reduce the cost for power used by the computing systems at the flexible datacenters **220**. The flexible datacenters **220** control system or the remote master control system **262** may monitor power conditions and other factors to determine whether the flexible datacenters **220** should use power from either the generation station **202**, grid power, the energy storage system **218**, none of the sources, or a subset of sources during a given time range. Other arrangements are possible as well. For example, the arrangement of FIG. **2** illustrates each flexible datacenter **220** as connected via a single connector **242** to energy storage system **218**, generation station **202**, and metered grid power via **256**A. However, one or more flexible datacenters **220** may have independent switched connections to each energy source, allowing the one or more flexible datacenters **220** to operate from different energy sources than other flexible datacenters **220** at the same time.

The selection of which power source to use at a flexible datacenter (e.g., the flexible datacenters **220**) or another type of BTM load can change based on various factors, such as the cost and availability of power from both sources, the type of computing systems using the power at the flexible datacenters **220** (e.g., some systems may require a reliable source of power for a long period), the nature of the computational operations being performed at the flexible datacenters **220** (e.g., a high priority task may require immediate completion regardless of cost), and temperature and weather conditions, among other possible factors. As such, a datacenter control system at the flexible datacenters **220**, the remote master control system **262**, or another entity (e.g., an operator at the generation station **202**) may also influence and/or determine the source of power that the flexible datacenters **220** use at a given time to complete computational operations.

In some example embodiments, the flexible datacenters **220** may use power from the different sources to serve different purposes. For example, the flexible datacenters **220** may use metered power from grid power to power one or more systems at the flexible datacenters **220** that are configured to be always-on (or almost always on), such as a control and/or communication system and/or one or more computing systems (e.g., a set of computing systems performing highly important computational operations). The flexible datacenters **220** may use BTM power to power other components within the flexible datacenters **220**, such as one or more computing systems that perform less critical computational operations.

In some examples, one or more flexible datacenters **220** may be deployed at the generation station **202**. In other examples, flexible datacenters **220** may be deployed at a location geographically remote from the generation station **202**, while still maintaining a BTM power connection to the generation station **202**.

In another example arrangement, the generation station **202** may be connected to a first BTM load (e.g., a flexible datacenter **220**) and may supply power to additional BTM loads via connections between the first BTM load and the additional BTM loads (e.g., a connection between a flexible datacenter **220** and another flexible datacenter **220**).

The arrangement in FIG. **2**, and components included therein, are for non-limiting illustration purposes and other arrangements are contemplated in examples. For instance, in another example embodiment, the arrangement of FIG. **2** may include more or fewer components, such as more BTM loads, different connections between power sources and loads, and/or a different number of datacenters. In addition, some examples may involve one or more components within the arrangement of FIG. **2** being combined or further divided.

Within the arrangement of FIG. **2**, a control system, such as the remote master control system **262** or another component (e.g., a control system associated with the grid operator, the generation station control system **216**, or a datacenter control system associated with a traditional datacenter or one or more flexible datacenters) may use information to efficiently manage various operations of some of the components within the arrangement of FIG. **2**. For example, the remote master control system **262** or another component may manage distribution and execution of computational operations at one or more traditional datacenters **260** and/or flexible datacenters **220** via one or more information-processing algorithms. These algorithms may utilize past and current information in real-time to manage operations of the different components. These algorithms may also make some predictions based on past trends and information analysis. In some examples, multiple computing systems may operate as a network to process information.

Information used to make decisions may include economic and/or power-related information, such as monitored power system conditions. Monitored power system conditions may include one or more of excess power generation at a generation station **202**, excess power at a generation station **202** that a connected grid cannot receive, power generation at a generation station **202** subject to economic curtailment, power generation at a generation station **202** subject to reliability curtailment, power generation at a generation station **202** subject to power factor correction, low power generation at a generation station **202**, start up conditions at a generation station **202**, transient power generation conditions at a generation station **202**, or testing conditions where there is an economic advantage to using behind-the-meter power generation at a generation station **202**. These different monitored power system conditions can be weighted differently during processing and analysis.

In some examples, the information can include the cost for power from available sources (e.g., BTM power at the generation station **202** versus metered grid power) to enable comparisons to be made which power source costs less. In some instances, the information may include historic prices for power to enable the remote master control system **262** or another system to predict potential future prices in similar situations (e.g., the cost of power tends to trend upwards for grid power during warmer weather and peak-use hours). The information may also indicate the availability of power from the various sources (e.g., BTM power at the generation

station **262**, the energy storage system **218** at the generation station **262**, and/or metered grid power).

In addition, the information may also include other data, including information associated with operations at components within the arrangement. For instance, the information may include data associated with performance of operations at the flexible datacenters **220** and the traditional datacenters **260**, such as the number of computational tasks currently being performed, the types of tasks being performed (e.g., type of computational operation, time-sensitivity, etc.), the number, types, and capabilities of available computing systems, the amount of computational tasks awaiting performance, and the types of computing systems at one or more datacenters, among others. The information may also include data specifying the conditions at one or more datacenters (e.g., whether or not the temperatures are in a desired range, the amount of power available within an energy storage system such as **218**), the amount of computational tasks awaiting performance in the queue of one or more of the datacenters, and the identities of the entities associated with the computational operations at one or more of the datacenters. Entities associated with computational operations may be, for example, owners of the datacenters, customers who purchase computational time at the datacenters, or other entities.

The information used by the remote master control system **262** or another component may include data associated with the computational operations to be performed, such as deadlines, priorities (e.g., high vs. low priority tasks), cost to perform based on required computing systems, the optimal computing systems (e.g., CPU vs GPU vs ASIC; processing unit capabilities, speeds, or frequencies, or instructional sets executable by the processing units) for performing each requested computational task, and prices each entity (e.g., company) is willing to pay for computational operations to be performed or otherwise supported via computing systems at a traditional datacenter **260** or a flexible datacenter **220**, among others. In addition, the information may also include other data (e.g., weather conditions at locations of datacenters or power sources, any emergencies associated with a datacenter or power source, or the current value of bids associated with an auction for computational tasks).

The information may be updated in-real time and used to make the different operational decisions within the arrangement of FIG. **2**. For instance, the information may help a component (e.g., the remote master control system **262** or a control system at a flexible datacenter **220**) determine when to ramp up or ramp down power use at a flexible datacenter **220** or when to switch one or more computing systems at a flexible datacenter **220** into a low power mode or to operate at a different frequency, among other operational adjustments. The information can additionally or alternatively help a component within the arrangement of FIG. **2** to determine when to transfer computational operations between computing systems or between datacenters based on various factors. In some instances, the information may also be used to determine when to temporarily stop performing a computational operation or when to perform a computational operation at multiple sites for redundancy or other reasons. The information may further be used to determine when to accept new computational operations from entities or when to temporarily suspend accepting new tasks to be performed due to lack of computing system availability.

The remote master control system **262** represents a computing system that is capable of obtaining, managing, and using the information described above to manage and oversee one or more operations within the arrangement of FIG. **2**. As such, the remote master control system **262** may be one or more computing systems configured to process all, or a subset of, the information described above, such as power, environment, computational characterization, and economic factors to assist with the distribution and execution of computing operations among one or more datacenters. For instance, the remote master control system **262** may be configured to obtain and delegate computational operations among one or more datacenters based on a weighted analysis of a variety of factors, including one or more of the cost and availability of power, the types and availability of the computing systems at each datacenter, current and predicted weather conditions at the different locations of flexible datacenters (e.g., flexible datacenters **220**) and generation stations (e.g., generation stations **202**), levels of power storage available at one or more energy storage systems (e.g., energy storage system **218**), and deadlines and other attributes associated with particular computational operations, among other possible factors. As such, the analysis of information performed by the remote master control system **262** may vary within examples. For instance, the remote master control system **262** may use real-time information to determine whether or not to route a computational operation to a particular flexible datacenter (e.g., a flexible datacenter **220**) or to transition a computational operation between datacenters (e.g., from traditional datacenter **260** to a flexible datacenter **220**).

As shown in FIG. **2**, the generation station **202** may be able to supply power to the grid and/or BTM loads such as flexible datacenters **220**. With such a configuration, the generation station **202** may selectively provide power to the BTM loads and/or the grid based on economic and power availability considerations. For example, the generation station **202** may supply power to the grid when the price paid for the power exceeds a particular threshold (e.g., the power price offered by operators of the flexible datacenters **220**). In some instances, the operator of a flexible datacenter and the operator of a generation station capable of supplying BTM power to the flexible datacenter may utilize a predefined arrangement (e.g., a contract) that specifies a duration and/or price range when the generation station may supply power to the flexible datacenter.

The remote master control system **262** may be capable of directing one or more flexible datacenters **220** to ramp-up or ramp-down to desired power consumption levels, and/or to control cooperative action of multiple flexible datacenters by determining how to power each individual flexible datacenter **220** in accordance with operational directives.

The configuration of the remote master control system **262** can vary within examples as further discussed with respect to FIGS. **2**, **3**, and **7-9**. The remote master control system **262** may operate as a single computing system or may involve a network of computing systems. Preferably, the remote master control system **262** is implemented across one or more servers in a fault-tolerant operating environment that ensures continuous uptime and connectivity by virtue of its distributed nature. Alternatively, although the remote master control system **262** is shown as a physically separate component arrangement for FIG. **2**, the remote master control system **262** may be combined with another component in other embodiments. To illustrate an example, the remote master control system **262** may operate as part of a flexible datacenter (e.g., a computing system or a datacenter control system of the flexible datacenter **220**), includ-

ing sharing components with a flexible datacenter, sharing power with a flexible datacenter, and/or being co-located with a flexible datacenter.

In addition, the remote master control system **262** may communicate with components within the arrangement of FIG. **2** using various communication technologies, including wired and wireless communication technologies. For instance, the remote master control system **262** may use wired (not illustrated) or wireless communication to communicate with datacenter control systems or other computing systems at the flexible datacenters **220** and the traditional datacenters **260**. The remote master control system **262** may also communicate with entities inside or outside the arrangement of FIG. **2** and other components within the arrangement of FIG. **2** via wired or wireless communication. For instance, the remote master control system **262** may use wireless communication to obtain computational operations from entities seeking support for the computational operations at one or more datacenters in exchange for payment. The remote master control system **262** may communicate directly with the entities or may obtain the computational operations from the traditional datacenters **260**. For instance, an entity may submit jobs (e.g., computational operations) to one or more traditional datacenters **260**. The remote master control system **262** may determine that transferring one or more of the computational operations to a flexible datacenter **220** may better support the transferred computational operations. For example, the remote master control system **262** may determine that the transfer may enable the computational operations to be completed quicker and/or at a lower cost. In some examples, the remote master control system **262** may communicate with the entity to obtain approval prior to transferring the one or more computational operations.

The remote master control system **262** may also communicate with grid operators and/or an operator of generation station **202** to help determine power management strategies when distributing computational operations across the various datacenters. In addition, the remote master control system **262** may communicate with other sources, such as weather prediction systems, historical and current power price databases, and auction systems, etc.

In further examples, the remote master control system **262** or another computing system within the arrangement of FIG. **2** may use wired or wireless communication to submit bids within an auction that involves a bidder (e.g., the highest bid) obtaining computational operations or other tasks to be performed. Particularly, the remote master control system **262** may use the information discussed above to develop bids to obtain computing operations for performance at available computing systems at flexible datacenters (e.g., flexible datacenters **220**).

In the example arrangement shown in FIG. **2**, the flexible datacenters **220** represent example loads that can receive power behind-the-meter from the generation station **202**. In such a configuration, the flexible datacenters **220** may obtain and utilize power behind-the-meter from the generation station **202** to perform various computational operations. Performance of a computational operation may involve one or more computing systems providing resources useful in the computational operation. For instance, the flexible datacenters **220** may include one or more computing systems configured to store information, perform calculations and/or parallel processes, perform simulations, mine cryptocurrencies, and execute applications, among other potential tasks. The computing systems can be specialized or generic and can be arranged at each flexible datacenter **220** in a variety of ways (e.g., straight configuration, zig-zag configuration) as further discussed with respect to FIGS. **6**A, **6**B. Furthermore, although the example arrangement illustrated in FIG. **2** shows configurations where flexible datacenters **220** serve as BTM loads, other types of loads can be used as BTM loads within examples.

The arrangement of FIG. **2** includes the traditional datacenters **260** coupled to metered grid power. The traditional datacenters **260** using metered grid power to provide computational resources to support computational operations. One or more enterprises may assign computational operations to the traditional datacenters **260** with expectations that the datacenters reliably provide resources without interruption (i.e., non-intermittently) to support the computational operations, such as processing abilities, networking, and/or volatile storage. Similarly, one or more enterprises may also request computational operations to be performed by the flexible datacenters **220**. The flexible datacenters **220** differ from the traditional datacenters **260** in that the flexible datacenters **220** are arranged and/or configured to be connected to BTM power, are expected to operate intermittently, and are expected to ramp load (and thus computational capability) up or down regularly in response to control directives. In some examples, the flexible datacenters **220** and the traditional datacenters **260** may have similar configurations and may only differ based on the source(s) of power relied upon to power internal computing systems. Preferably, however, the flexible datacenters **220** include particular fast load ramping abilities (e.g., quickly increase or decrease power usage) and are intended and designed to effectively operate during intermittent periods of time.

FIG. **3** shows a block diagram of the remote master control system **300** according to one or more example embodiments. Remote master control system **262** may take the form of remote master control system **300**, or may include less than all components in remote master control system **300**, different components than in remote master control system **300**, and/or more components than in remote master control system **300**.

The remote master control system **300** may perform one or more operations described herein and may include a processor **302**, a data storage unit **304**, a communication interface **306**, a user interface **308**, an operations and environment analysis module **310**, and a queue system **312**. In other examples, the remote master control system **300** may include more or fewer components in other possible arrangements.

As shown in FIG. **3**, the various components of the remote master control system **300** can be connected via one or more connection mechanisms (e.g., a connection mechanism **314**). In this disclosure, the term "connection mechanism" means a mechanism that facilitates communication between two or more devices, systems, components, or other entities. For instance, a connection mechanism can be a simple mechanism, such as a cable, PCB trace, or system bus, or a relatively complex mechanism, such as a packet-based communication network (e.g., LAN, WAN, and/or the Internet). In some instances, a connection mechanism can include a non-tangible medium (e.g., where the connection is wireless).

As part of the arrangement of FIG. **2**, the remote master control system **300** (corresponding to remote master control system **262**) may perform a variety of operations, such as management and distribution of computational operations among datacenters, monitoring operational, economic, and environment conditions, and power management. For instance, the remote master control system **300** may obtain

computational operations from one or more enterprises for performance at one or more datacenters. The remote master control system **300** may subsequently use information to distribute and assign the computational operations to one or more datacenters (e.g., the flexible datacenters **220**) that have the resources (e.g., particular types of computing systems and available power) available to complete the computational operations. In some examples, the remote master control system **300** may assign all incoming computational operation requests to the queue system **312** and subsequently assign the queued requests to computing systems based on an analysis of current market and power conditions.

Although the remote master control system **300** is shown as a single entity, a network of computing systems may perform the operations of the remote master control system **300** in some examples. For example, the remote master control system **300** may exist in the form of computing systems (e.g., datacenter control systems) distributed across multiple datacenters.

The remote master control system **300** may include one or more processors **302**. As such, the processor **302** may represent one or more general-purpose processors (e.g., a microprocessor) and/or one or more special-purpose processors (e.g., a digital signal processor (DSP)). In some examples, the processor **302** may include a combination of processors within examples. The processor **302** may perform operations, including processing data received from the other components within the arrangement of FIG. **2** and data obtained from external sources, including information such as weather forecasting systems, power market price systems, and other types of sources or databases.

The data storage unit **304** may include one or more volatile, non-volatile, removable, and/or non-removable storage components, such as magnetic, optical, or flash storage, and/or can be integrated in whole or in part with the processor **302**. As such, the data storage unit **304** may take the form of a non-transitory computer-readable storage medium, having stored thereon program instructions (e.g., compiled or non-compiled program logic and/or machine code) that, when executed by the processor **302**, cause the remote master control system **300** to perform one or more acts and/or functions, such as those described in this disclosure. Such program instructions can define and/or be part of a discrete software application. In some instances, the remote master control system **300** can execute program instructions in response to receiving an input, such as from the communication interface **306**, the user interface **308**, or the operations and environment analysis module **310**. The data storage unit **304** may also store other information, such as those types described in this disclosure.

In some examples, the data storage unit **304** may serve as storage for information obtained from one or more external sources. For example, data storage unit **304** may store information obtained from one or more of the traditional datacenters **260**, a generation station **202**, a system associated with the grid, and flexible datacenters **220**. As examples only, data storage **304** may include, in whole or in part, local storage, dedicated server-managed storage, network attached storage, and/or cloud-based storage, and/or combinations thereof.

The communication interface **306** can allow the remote master control system **300** to connect to and/or communicate with another component according to one or more protocols. For instance, the communication interface **306** may be used to obtain information related to current, future, and past prices for power, power availability, current and predicted weather conditions, and information regarding the different datacenters (e.g., current workloads at datacenters, types of computing systems available within datacenters, price to obtain power at each datacenter, levels of power storage available and accessible at each datacenter, etc.). In an example, the communication interface **306** can include a wired interface, such as an Ethernet interface or a high-definition serial-digital-interface (HD-SDI). In another example, the communication interface **406** can include a wireless interface, such as a cellular, satellite, WiMAX, or WI-FI interface. A connection can be a direct connection or an indirect connection, the latter being a connection that passes through and/or traverses one or more components, such as such as a router, switcher, or other network device. Likewise, a wireless transmission can be a direct transmission or an indirect transmission. The communication interface **306** may also utilize other types of wireless communication to enable communication with datacenters positioned at various locations.

The communication interface **306** may enable the remote master control system **300** to communicate with the components of the arrangement of FIG. **2**. In addition, the communication interface **306** may also be used to communicate with the various datacenters, power sources, and different enterprises submitting computational operations for the datacenters to support.

The user interface **308** can facilitate interaction between the remote master control system **300** and an administrator or user, if applicable. As such, the user interface **308** can include input components such as a keyboard, a keypad, a mouse, a touch-sensitive panel, a microphone, and/or a camera, and/or output components such as a display device (which, for example, can be combined with a touch-sensitive panel), a sound speaker, and/or a haptic feedback system. More generally, the user interface **308** can include hardware and/or software components that facilitate interaction between remote master control system **300** and the user of the system.

In some examples, the user interface **308** may enable the manual examination and/or manipulation of components within the arrangement of FIG. **2**. For instance, an administrator or user may use the user interface **308** to check the status of, or change, one or more computational operations, the performance or power consumption at one or more datacenters, the number of tasks remaining within the queue system **312**, and other operations. As such, the user interface **308** may provide remote connectivity to one or more systems within the arrangement of FIG. **2**.

The operations and environment analysis module **310** represents a component of the remote master control system **300** associated with obtaining and analyzing information to develop instructions/directives for components within the arrangement of FIG. **2**. The information analyzed by the operations and environment analysis module **310** can vary within examples and may include the information described above with respect predicting and/or directing the use of BTM power. For instance, the operations and environment analysis module **310** may obtain and access information related to the current power state of computing systems operating as part of the flexible datacenters **220** and other datacenters that the remote master control system **300** has access to. This information may be used to determine when to adjust power usage or mode of one or more computing systems. In addition, the remote master control system **300** may provide instructions a flexible datacenter **220** to cause a subset of the computing systems to transition into a low power mode to consume less power while still performing

operations at a slower rate. The remote master control system **300** may also use power state information to cause a set of computing systems at a flexible datacenter **220** to operate at a higher power consumption mode. In addition, the remote master control system **300** may transition computing systems into sleep states or power on/off based on information analyzed by the operations and environment analysis module **310**.

In some examples, the operations and environment analysis module **310** may use location, weather, activity levels at the flexible datacenters or the generation station, and power cost information to determine control strategies for one or more components in the arrangement of FIG. **2**. For instance, the remote master control system **300** may use location information for one or more datacenters to anticipate potential weather conditions that could impact access to power. In addition, the operations and environment analysis module **310** may assist the remote master control system **300** determine whether to transfer computational operations between datacenters based on various economic and power factors.

The queue system **312** represents a queue capable of organizing computational operations to be performed by one or more datacenters. Upon receiving a request to perform a computational operation, the remote master control system **300** may assign the computational operation to the queue until one or more computing systems are available to support the computational operation. The queue system **312** may be used for organizing and transferring computational tasks in real time.

The organizational design of the queue system **312** may vary within examples. In some examples, the queue system **312** may organize indications (e.g., tags, pointers) to sets of computational operations requested by various enterprises. The queue system **312** may operate as a First-In-First-Out (FIFO) data structure. In a FIFO data structure, the first element added to the queue will be the first one to be removed. As such, the queue system **312** may include one or more queues that operate using the FIFO data structure.

In some examples, one or more queues within the queue system **312** may use other designs of queues, including rules to rank or organize queues in a particular manner that can prioritize some sets of computational operations over others. The rules may include one or more of an estimated cost and/or revenue to perform each set of computational operations, an importance assigned to each set of computational operations, and deadlines for initiating or completing each set of computational operations, among others. Examples using a queue system are further described below with respect to FIG. **9**.

In some examples, the remote master control system **300** may be configured to monitor one or more auctions to obtain computational operations for datacenters to support. Particularly, the remote master control system **300** may use resource availability and power prices to develop and submit bids to an external or internal auction system for the right to support particular computational operations. As a result, the remote master control system **300** may identify computational operations that could be supported at one or more flexible datacenters **220** at low costs.

FIG. **4** is a block diagram of a generation station **400**, according to one or more example embodiments. Generation station **202** may take the form of generation station **400**, or may include less than all components in generation station **400**, different components than in generation station **400**, and/or more components than in generation station **400**. The generation station **400** includes power generation equipment **401**, a communication interface **408**, a behind-the-meter interface **406**, a grid interface **404**, a user interface **410**, a generation station control system **414**, and power transformation equipment **402**. The power generation equipment **210** may take the form of power generation equipment **401**, or may include less than all components in power generation equipment **401**, different components than in power generation equipment **401**, and/or more components than in power generation equipment **401**. Generation station control system **216** may take the form of generation station control system **414**, or may include less than all components in generation station control system **414**, different components than in generation station control system **414**, and/or more components than in generation station control system **414**. Some or all of the components generation station **400** may be connected via a communication interface **516**. These components are illustrated in FIG. **4** to convey an example configuration for the generation station **400** (corresponding to generation station **202** shown in FIG. **2**). In other examples, the generation station **400** may include more or fewer components in other arrangements.

The generation station **400** can correspond to any type of grid-connected utility-scale power producer capable of supplying power to one or more loads. The size, amount of power generated, and other characteristics of the generation station **400** may differ within examples. For instance, the generation station **400** may be a power producer that provides power intermittently. The power generation may depend on monitored power conditions, such as weather at the location of the generation station **400** and other possible conditions. As such, the generation station **400** may be a temporary arrangement, or a permanent facility, configured to supply power. The generation station **400** may supply BTM power to one or more loads and supply metered power to the electrical grid. Particularly, the generation station **400** may supply power to the grid as shown in the arrangement of FIG. **2**.

The power generation equipment **401** represents the component or components configured to generate utility-scale power. As such, the power generation equipment **401** may depend on the type of facility that the generation station **400** corresponds to. For instance, the power generation equipment **401** may correspond to electric generators that transform kinetic energy into electricity. The power generation equipment **401** may use electromagnetic induction to generate power. In other examples, the power generation equipment **401** may utilize electrochemistry to transform chemical energy into power. The power generation equipment **401** may use the photovoltaic effect to transform light into electrical energy. In some examples, the power generation equipment **401** may use turbines to generate power. The turbines may be driven by, for example, wind, water, steam or burning gas. Other examples of power production are possible.

The communication interface **408** can enable the generation station **400** to communicate with other components within the arrangement of FIG. **2**. As such, the communication interface **408** may operate similarly to the communication interface **306** of the remote master control system **300** and the communication interface **503** of the flexible datacenter **500**.

The generation station control system **414** may be one or more computing systems configured to control various aspects of the generation station **400**.

The BTM interface **406** is a module configured to enable the power generation equipment **401** to supply BTM power to one or more loads and may include multiple components.

The arrangement of the BTM interface **406** may differ within examples based on various factors, such as the number of flexible datacenters **220** (or **500**) coupled to the generation station **400**, the proximity of the flexible datacenters **220** (or **500**), and the type of generation station **400**, among others. In some examples, the BTM interface **406** may be configured to enable power delivery to one or more flexible datacenters positioned near the generation station **400**. Alternatively, the BTM interface **406** may also be configured to enable power delivery to one or more flexible datacenters **220** (or **500**) positioned remotely from the generation station **400**.

The grid interface **404** is a module configured to enable the power generation equipment **401** to supply power to the grid and may include multiple components. As such, the grid interface **404** may couple to one or more transmission lines (e.g., transmission lines **404***a* shown in FIG. **2**) to enable delivery of power to the grid.

The user interface **410** represents an interface that enables administrators and/or other entities to communicate with the generation station **400**. As such, the user interface **410** may have a configuration that resembles the configuration of the user interface **308** shown in FIG. **3**. An operator may utilize the user interface **410** to control or monitor operations at the generation station **400**.

The power transformation equipment **402** represents equipment that can be utilized to enable power delivery from the power generation equipment **401** to the loads and to transmission lines linked to the grid. Example power transformation equipment **402** includes, but is not limited to, transformers, inverters, phase converters, and power conditioners.

FIG. **5** shows a block diagram of a flexible datacenter **500**, according to one or more example embodiments. Flexible datacenters **220** may take the form of flexible datacenter **500**, or may include less than all components in flexible datacenter **500**, different components than in flexible datacenter **500**, and/or more components than in flexible datacenter **500**. In the example embodiment shown in FIG. **5**, the flexible datacenter **500** includes a power input system **502**, a communication interface **503**, a datacenter control system **504**, a power distribution system **506**, a climate control system **508**, one or more sets of computing systems **512**, and a queue system **514**. These components are shown connected by a communication bus **528**. In other embodiments, the configuration of flexible datacenter **500** can differ, including more or fewer components. In addition, the components within flexible datacenter **500** may be combined or further divided into additional components within other embodiments.

The example configuration shown in FIG. **5** represents one possible configuration for a flexible datacenter. As such, each flexible datacenter may have a different configuration when implemented based on a variety of factors that may influence its design, such as location and temperature that the location, particular uses for the flexible datacenter, source of power supplying computing systems within the flexible datacenter, design influence from an entity (or entities) that implements the flexible datacenter, and space available for the flexible datacenter. Thus, the embodiment of flexible datacenter **220** shown in FIG. **2** represents one possible configuration for a flexible datacenter out of many other possible configurations.

The flexible datacenter **500** may include a design that allows for temporary and/or rapid deployment, setup, and start time for supporting computational operations. For instance, the flexible datacenter **500** may be rapidly deployed at a location near a source of generation station power (e.g., near a wind farm or solar farm). Rapid deployment may involve positioning the flexible datacenter **500** at a target location and installing and/or configuring one or more racks of computing systems within. The racks may include wheels to enable swift movement of the computing systems. Although the flexible datacenter **500** could theoretically be placed anywhere, transmission losses may be minimized by locating it proximate to BTM power generation.

The physical construction and layout of the flexible datacenter **500** can vary. In some instances, the flexible datacenter **500** may utilize a metal container (e.g., a metal container **602** shown in FIG. **6**A). In general, the flexible datacenter **500** may utilize some form of secure weatherproof housing designed to protect interior components from wind, weather, and intrusion. The physical construction and layout of example flexible datacenters are further described with respect to FIGS. **6**A-**6**B.

Within the flexible datacenter **500**, various internal components enable the flexible datacenter **500** to utilize power to perform some form of operations. The power input system **502** is a module of the flexible datacenter **500** configured to receive external power and input the power to the different components via assistance from the power distribution system **506**. As discussed with respect to FIG. **2**, the sources of external power feeding a flexible datacenter can vary in both quantity and type (e.g., the generation stations **202**, **400**, grid-power, energy storage systems). Power input system **502** includes a BTM power input sub-system **522**, and may additionally include other power input sub-systems (e.g., a grid-power input sub-system **524** and/or an energy storage input sub-system **526**). In some instances, the quantity of power input sub-systems may depend on the size of the flexible datacenter and the number and/or type of computing systems being powered. In an example embodiment, the flexible datacenter may use grid power as the primary power supply.

In some embodiments, the power input system **502** may include some or all of flexible datacenter Power Equipment **220**B. The power input system **502** may be designed to obtain power in different forms (e.g., single phase or three-phase behind-the-meter alternating current ("AC") voltage, and/or direct current ("DC") voltage). As shown, the power input system **502** includes a BTM power input sub-system **522**, a grid power input sub-system **524**, and an energy input sub-system **526**. These sub-systems are included to illustrate example power input sub-systems that the flexible datacenter **500** may utilize, but other examples are possible. In addition, in some instances, these sub-systems may be used simultaneously to supply power to components of the flexible datacenter **500**. The sub-systems may also be used based on available power sources.

In some implementations, the BTM power input sub-system **522** may include one or more AC-to-AC step-down transformers used to step down supplied medium-voltage AC to low voltage AC (e.g., 120V to 600V nominal) used to power computing systems **512** and/or other components of flexible datacenter **500**. The power input system **502** may also directly receive single-phase low voltage AC from a generation station as BTM power, from grid power, or from a stored energy system such as energy storage system **218**. In some implementations, the power input system **502** may provide single-phase AC voltage to the datacenter control system **504** (and/or other components of flexible datacenter **500**) independent of power supplied to computing systems **512** to enable the datacenter control system **504** to perform

management operations for the flexible datacenter **500**. For instance, the grid power input sub-system **524** may use grid power to supply power to the datacenter control system **504** to ensure that the datacenter control system **504** can perform control operations and communicate with the remote master control system **300** (or **262**) during situations when BTM power is not available. As such, the datacenter control system **504** may utilize power received from the power input system **502** to remain powered to control the operation of flexible datacenter **500**, even if the computational operations performed by the computing system **512** are powered intermittently. In some instances, the datacenter control system **504** may switch into a lower power mode to utilize less power while still maintaining the ability to perform some functions.

The power distribution system **506** may distribute incoming power to the various components of the flexible datacenter **500**. For instance, the power distribution system **506** may direct power (e.g., single-phase or three-phase AC) to one or more components within flexible datacenter **500**. In some embodiments, the power distribution system **506** may include some or all of flexible datacenter Power Equipment **220**B.

In some examples, the power input system **502** may provide three phases of three-phase AC voltage to the power distribution system **506**. The power distribution system **506** may controllably provide a single phase of AC voltage to each computing system or groups of computing systems **512** disposed within the flexible datacenter **500**. The datacenter control system **504** may controllably select which phase of three-phase nominal AC voltage that power distribution system **506** provides to each computing system **512** or groups of computing systems **512**. This is one example manner in which the datacenter control system **504** may modulate power delivery (and load at the flexible datacenter **500**) by ramping-up flexible datacenter **500** to fully operational status, ramping-down flexible datacenter **500** to offline status (where only datacenter control system **504** remains powered), reducing load by withdrawing power delivery from, or reducing power to, one or more of the computing systems **512** or groups of the computing systems **512**, or modulating power factor correction for the generation station **300** (or **202**) by controllably adjusting which phases of three-phase nominal AC voltage are used by one or more of the computing systems **512** or groups of the computing systems **512**. The datacenter control system **504** may direct power to certain sets of computing systems based on computational operations waiting for computational resources within the queue system **514**. In some embodiments, the flexible datacenter **500** may receive BTM DC power to power the computing systems **512**.

One of ordinary skill in the art will recognize that a voltage level of three-phase AC voltage may vary based on an application or design and the type or kind of local power generation. As such, a type, kind, or configuration of the operational AC-to-AC step down transformer (not shown) may vary based on the application or design. In addition, the frequency and voltage level of three-phase AC voltage, single-phase AC voltage, and DC voltage may vary based on the application or design in accordance with one or more embodiments.

As discussed above, the datacenter control system **504** may perform operations described herein, such as dynamically modulating power delivery to one or more of the computing systems **512** disposed within flexible datacenter **500**. For instance, the datacenter control system **504** may modulate power delivery to one or more of the computing systems **512** based on various factors, such as BTM power availability or an operational directive from a generation station **262** or **300** control system, a remote master control system **262** or **300**, or a grid operator. In some examples, the datacenter control system **504** may provide computational operations to sets of computing systems **512** and modulate power delivery based on priorities assigned to the computational operations. For instance, an important computational operation (e.g., based on a deadline for execution and/or price paid by an entity) may be assigned to a particular computing system or set of computing systems **512** that has the capacity, computational abilities to support the computational operation. In addition, the datacenter control system **504** may also prioritize power delivery to the computing system or set of computing systems **512**.

In some example, the datacenter control system **504** may further provide directives to one or more computing systems to change operations in some manner. For instance, the datacenter control system **504** may cause one or more computing systems **512** to operate at a lower or higher frequency, change clock cycles, or operate in a different power consumption mode (e.g., a low power mode). These abilities may vary depending on types of computing systems **512** available at the flexible datacenter **500**. As a result, the datacenter control system **504** may be configured to analyze the computing systems **512** available either on a periodic basis (e.g., during initial set up of the flexible datacenter **500**) or in another manner (e.g., when a new computational operation is assigned to the flexible datacenter **500**).

The datacenter control system **504** may also implement directives received from the remote master control system **262** or **300**. For instance, the remote master control system **262** or **300** may direct the flexible datacenter **500** to switch into a low power mode. As a result, one or more of the computing systems **512** and other components may switch to the low power mode in response.

The datacenter control system **504** may utilize the communication interface **503** to communicate with the remote master control system **262** or **300**, other datacenter control systems of other datacenters, and other entities. As such, the communication interface **503** may include components and operate similar to the communication interface **306** of the remote master control system **300** described with respect to FIG. **4**.

The flexible datacenter **500** may also include a climate control system **508** to maintain computing systems **512** within a desired operational temperature range. The climate control system **508** may include various components, such as one or more air intake components, an evaporative cooling system, one or more fans, an immersive cooling system, an air conditioning or refrigerant cooling system, and one or more air outtake components. One of ordinary skill in the art will recognize that any suitable heat extraction system configured to maintain the operation of computing systems **512** within the desired operational temperature range may be used.

The flexible datacenter **500** may further include an energy storage system **510**. The energy storage system **510** may store energy for subsequent use by computing systems **512** and other components of flexible datacenter **500**. For instance, the energy storage system **510** may include a battery system. The battery system may be configured to convert AC voltage to DC voltage and store power in one or more storage cells. In some instances, the battery system may include a DC-to-AC inverter configured to convert DC

voltage to AC voltage, and may further include an AC phase-converter, to provide AC voltage for use by flexible datacenter **500**.

The energy storage system **510** may be configured to serve as a backup source of power for the flexible datacenter **500**. For instance, the energy storage system **510** may receive and retain power from a BTM power source at a low cost (or no cost at all). This low-cost power can then be used by the flexible datacenter **500** at a subsequent point, such as when BTM power costs more. Similarly, the energy storage system **510** may also store energy from other sources (e.g., grid power). As such, the energy storage system **510** may be configured to use one or more of the sub-systems of the power input system **502**.

In some examples, the energy storage system **510** may be external to the flexible datacenter **500**. For instance, the energy storage system **510** may be an external source that multiple flexible datacenters utilize for back-up power.

The computing systems **512** represent various types of computing systems configured to perform computational operations. Performance of computational operations include a variety of tasks that one or more computing systems may perform, such as data storage, calculations, application processing, parallel processing, data manipulation, cryptocurrency mining, and maintenance of a distributed ledger, among others. As shown in FIG. **5**, the computing systems **512** may include one or more CPUs **516**, one or more GPUs **518**, and/or one or more Application-Specific Integrated Circuits (ASIC's) **520**. Each type of computing system **512** may be configured to perform particular operations or types of operations.

Due to different performance features and abilities associated with the different types of computing systems, the datacenter control system **504** may determine, maintain, and/or relay this information about the types and/or abilities of the computing systems, quantity of each type, and availability to the remote master control system **262** or **300** on a routine basis (e.g., periodically or on-demand). This way, the remote master control system **262** or **300** may have current information about the abilities of the computing systems **512** when distributing computational operations for performance at one or more flexible datacenters. Particularly, the remote master control system **262** or **300** may assign computational operations based on various factors, such as the types of computing systems available and the type of computing systems required by each computing operation, the availability of the computing systems, whether computing systems can operate in a low power mode, and/or power consumption and/or costs associated with operating the computing systems, among others.

The quantity and arrangement of these computing systems **512** may vary within examples. In some examples, the configuration and quantity of computing systems **512** may depend on various factors, such as the computational tasks that are performed by the flexible datacenter **500**. In other examples, the computing systems **512** may include other types of computing systems as well, such as DSPs, SIMDs, neural processors, and/or quantum processors.

As indicated above, the computing systems **512** can perform various computational operations, including in different configurations. For instance, each computing system may perform a particular computational operation unrelated to the operations performed at other computing systems. Groups of the computing systems **512** may also be used to work together to perform computational operations.

In some examples, multiple computing systems may perform the same computational operation in a redundant configuration. This redundant configuration creates a back-up that prevents losing progress on the computational operation in situations of a computing failure or intermittent operation of one or more computing systems. In addition, the computing systems **512** may also perform computational operations using a check point system. The check point system may enable a first computing system to perform operations up to a certain point (e.g., a checkpoint) and switch to a second computing system to continue performing the operations from that certain point. The check point system may also enable the datacenter control system **504** to communicate statuses of computational operations to the remote master control system **262** or **300**. This can further enable the remote master control system **262 300** to transfer computational operations between different flexible datacenters allowing computing systems at the different flexible datacenters to resume support of computational operations based on the check points.

The queue system **514** may operate similar to the queue system **312** of the remote master control system **300** shown in FIG. **3**. Particularly, the queue system **514** may help store and organize computational tasks assigned for performance at the flexible datacenter **500**. In some examples, the queue system **514** may be part of a distributed queue system such that each flexible datacenter in a fleet of flexible datacenter includes a queue, and each queue system **514** may be able to communicate with other queue systems. In addition, the remote master control system **262** or **300** may be configured to assign computational tasks to the queues located at each flexible datacenter (e.g., the queue system **514** of the flexible datacenter **500**). As such, communication between the remote master control system **262** or **300** and the datacenter control system **504** and/or the queue system **514** may allow organization of computational operations for the flexible datacenter **500** to support.

FIG. **6**A shows another structural arrangement for a flexible datacenter, according to one or more example embodiments. The particular structural arrangement shown in FIG. **6**A may be implemented at flexible datacenter **500**. The illustration depicts the flexible datacenter **500** as a mobile container **702** equipped with the power input system **502**, the power distribution system **506**, the climate control system **508**, the datacenter control system **504**, and the computing systems **512** arranged on one or more racks **604**. These components of flexible datacenter **500** may be arranged and organized according to an example structural region arrangement. As such, the example illustration represents one possible configuration for the flexible datacenter **500**, but others are possible within examples.

As discussed above, the structural arrangement of the flexible datacenter **500** may depend on various factors, such as the ability to maintain temperature within the mobile container **602** within a desired temperature range. The desired temperature range may depend on the geographical location of the mobile container **602** and the type and quantity of the computing systems **512** operating within the flexible datacenter **500** as well as other possible factors. As such, the different design elements of the mobile container **602** including the inner contents and positioning of components may depend on factors that aim to maximize the use of space within mobile container **602**, lower the amount of power required to cool the computing systems **512**, and make setup of the flexible datacenter **500** efficient. For instance, a first flexible datacenter positioned in a cooler geographic region may include less cooling equipment than a second flexible datacenter positioned in a warmer geographic region.

As shown in FIG. **6**A, the mobile container **602** may be a storage trailer disposed on permanent or removable wheels and configured for rapid deployment. In other embodiments, the mobile container **602** may be a storage container (not shown) configured for placement on the ground and potentially stacked in a vertical or horizontal manner (not shown). In still other embodiments, the mobile container **602** may be an inflatable container, a floating container, or any other type or kind of container suitable for housing a mobile flexible datacenter. As such, the flexible datacenter **500** may be rapidly deployed on site near a source of unutilized behind-the-meter power generation. And in still other embodiments, the flexible datacenter **500** might not include a mobile container. For example, the flexible datacenter **500** may be situated within a building or another type of stationary environment.

FIG. **6**B shows the computing systems **512** in a straight-line configuration for installation within the flexible datacenter **500**, according to one or more example embodiments. As indicated above, the flexible datacenter **500** may include a plurality of racks **604**, each of which may include one or more computing systems **512** disposed therein. As discussed above, the power input system **502** may provide three phases of AC voltage to the power distribution system **506**. In some examples, the power distribution system **506** may controllably provide a single phase of AC voltage to each computing system **512** or group of computing systems **512** disposed within the flexible datacenter **500**. As shown in FIG. **6**B, for purposes of illustration only, eighteen total racks **604** are divided into a first group of six racks **606**, a second group of six racks **608**, and a third group of six racks **610**, where each rack contains eighteen computing systems **512**. The power distribution system (**506** of FIG. **5**) may, for example, provide a first phase of three-phase AC voltage to the first group of six racks **606**, a second phase of three-phase AC voltage to the second group of six racks **608**, and a third phase of three-phase AC voltage to the third group of six racks **610**. In other embodiments, the quantity of racks and computing systems can vary.

FIG. **7** shows a control distribution system **700** of the flexible datacenter **500** according to one or more example embodiments. The system **700** includes a grid operator **702**, a generation station control system **216**, a remote master control system **300**, and a flexible datacenter **500**. As such, the system **700** represents one example configuration for controlling operations of the flexible datacenter **500**, but other configurations may include more or fewer components in other arrangements.

The datacenter control system **504** may independently or cooperatively with one or more of the generation station control system **414**, the remote master control system **300**, and/or the grid operator **702** modulate power at the flexible datacenter **500**. During operations, the power delivery to the flexible datacenter **500** may be dynamically adjusted based on conditions or operational directives. The conditions may correspond to economic conditions (e.g., cost for power, aspects of computational operations to be performed), power-related conditions (e.g., availability of the power, the sources offering power), demand response, and/or weather-related conditions, among others.

The generation station control system **414** may be one or more computing systems configured to control various aspects of a generation station (not independently illustrated, e.g., **216** or **400**). As such, the generation station control system **414** may communicate with the remote master control system **300** over a networked connection **706** and with the datacenter control system **704** over a networked or other data connection **708**.

As discussed with respect to FIGS. **2** and **3**, the remote master control system **300** can be one or more computing systems located offsite, but connected via a network connection **710** to the datacenter control system **504**. The remote master control system **300** may provide supervisory controls or override control of the flexible datacenter **500** or a fleet of flexible datacenters (not shown).

The grid operator **702** may be one or more computing systems that are configured to control various aspects of the power grid (not independently illustrated) that receives power from the generation station. The grid operator **702** may communicate with the generation station control system **300** over a networked or other data connection **712**.

The datacenter control system **504** may monitor BTM power conditions at the generation station and determine when a datacenter ramp-up condition is met. The BTM power availability may include one or more of excess local power generation, excess local power generation that the grid cannot accept, local power generation that is subject to economic curtailment, local power generation that is subject to reliability curtailment, local power generation that is subject to power factor correction, conditions where the cost for power is economically viable (e.g., low cost to obtain power), low priced power, situations where local power generation is prohibitively low, start up situations, transient situations, or testing situations where there is an economic advantage to using locally generated behind-the-meter power generation, specifically power available at little to no cost and with no associated transmission or distribution losses or costs. For example, a datacenter control system may analyze future workload and near term weather conditions at the flexible datacenter.

In some instances, the datacenter ramp-up condition may be met if there is sufficient behind-the-meter power availability and there is no operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702** to go offline or reduce power. As such, the datacenter control system **504** may enable 714 the power input system **502** to provide power to the power distribution system **506** to power the computing systems **512** or a subset thereof.

The datacenter control system **504** may optionally direct one or more computing systems **512** to perform predetermined computational operations (e.g., distributed computing processes). For example, if the one or more computing systems **512** are configured to perform blockchain hashing operations, the datacenter control system **504** may direct them to perform blockchain hashing operations for a specific blockchain application, such as, for example, Bitcoin, Litecoin, or Ethereum. Alternatively, one or more computing systems **512** may be configured to perform high-throughput computing operations and/or high performance computing operations.

The remote master control system **300** may specify to the datacenter control system **504** what sufficient behind-the-meter power availability constitutes, or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently. For example, in certain circumstances, sufficient behind-the-meter power availability may be less than that required to fully power the entire flexible datacenter **500**. In such circumstances, the datacenter control system **504** may provide power to only a subset of computing systems, or operate the plurality of computing systems in a

lower power mode, that is within the sufficient, but less than full, range of power that is available. In addition, the computing systems **512** may adjust operational frequency, such as performing more or less processes during a given duration. The computing systems **512** may also adjust internal clocks via over-clocking or under-clocking when performing operations.

While the flexible datacenter **500** is online and operational, a datacenter ramp-down condition may be met when there is insufficient or anticipated to be insufficient, behind-the-meter power availability or there is an operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. The datacenter control system **504** may monitor and determine when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability. As noted above, sufficiency may be specified by the remote master control system **300** or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently.

An operational directive may be based on current dispatch-ability, forward looking forecasts for when behind-the-meter power is, or is expected to be, available, economic considerations, reliability considerations, operational considerations, or the discretion of the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. For example, the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may issue an operational directive to flexible datacenter **500** to go offline and power down. When the datacenter ramp-down condition is met, the datacenter control system **504** may disable power delivery to the plurality of computing systems (e.g., **512**). The datacenter control system **504** may disable **714** the power input system **502** from providing power (e.g., three-phase nominal AC voltage) to the power distribution system **506** to power down the computing systems **512** while the datacenter control system **504** remains powered and is capable of returning service to operating mode at the flexible datacenter **500** when behind-the-meter power becomes available again.

While the flexible datacenter **500** is online and operational, changed conditions or an operational directive may cause the datacenter control system **504** to modulate power consumption by the flexible datacenter **500**. The datacenter control system **504** may determine, or the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in less power generation, availability, or economic feasibility, than would be necessary to fully power the flexible datacenter **500**. In such situations, the datacenter control system **504** may take steps to reduce or stop power consumption by the flexible datacenter **500** (other than that required to maintain operation of datacenter control system **504**).

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to reduce power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically reduce or withdraw power delivery to one or more computing systems **512** to meet the dictate. The datacenter control system **504** may controllably provide three-phase nominal AC voltage to a smaller subset of computing systems (e.g., **512**) to reduce power consumption. The datacenter control system **504** may dynamically reduce the power consumption of one or more computing systems by reducing their operating frequency or forcing them into a lower power mode through a network directive.

Similarly, the flexible datacenter **500** may ramp up power consumption based on various conditions. For instance, the datacenter control system **504** may determine, or the generation control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in greater power generation, availability, or economic feasibility. In such situations, the datacenter control system **504** may take steps to increase power consumption by the flexible datacenter **500**.

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to increase power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically increase power delivery to one or more computing systems **512** (or operations at the computing systems **512**) to meet the dictate. For instance, one or more computing systems **512** may transition into a higher power mode, which may involve increasing power consumption and/or operation frequency.

One of ordinary skill in the art will recognize that datacenter control system **504** may be configured to have a number of different configurations, such as a number or type or kind of the computing systems **512** that may be powered, and in what operating mode, that correspond to a number of different ranges of sufficient and available behind-the-meter power. As such, the datacenter control system **504** may modulate power delivery over a variety of ranges of sufficient and available unutilized behind-the-meter power availability.

FIG. **8** shows a control distribution system **800** of a fleet of flexible datacenters according to one or more example embodiments. The control distribution system **800** of the flexible datacenter **500** shown and described with respect to FIG. **7** may be extended to a fleet of flexible datacenters as illustrated in FIG. **8**. For example, a first generation station (not independently illustrated), such as a wind farm, may include a first plurality of flexible datacenters **802**, which may be collocated or distributed across the generation station. A second generation station (not independently illustrated), such as another wind farm or a solar farm, may include a second plurality of flexible datacenters **804**, which may be collocated or distributed across the generation station. One of ordinary skill in the art will recognize that the number of flexible datacenters deployed at a given station and the number of stations within the fleet may vary based on an application or design in accordance with one or more example embodiments.

The remote master control system **300** may provide directive to datacenter control systems of the fleet of flexible datacenters in a similar manner to that shown and described with respect to FIG. **7**, with the added flexibility to make high level decisions with respect to fleet that may be counterintuitive to a given station. The remote master control system **300** may make decisions regarding the issuance of operational directives to a given generation station based on, for example, the status of each generation station where flexible datacenters are deployed, the workload distributed across fleet, and the expected computational demand required for one or both of the expected workload and predicted power availability. In addition, the remote master control system **300** may shift workloads from the first plurality of flexible datacenters **802** to the second plurality of flexible datacenters **804** for any reason, including, for

example, a loss of BTM power availability at one generation station and the availability of BTM power at another generation station. As such, the remote master control system **300** may communicate with the generation station control systems **806**A, **806**B to obtain information that can be used to organize and distribute computational operations to the fleets of flexible datacenters **802**, **804**.

FIG. **9** shows a queue distribution arrangement for a traditional datacenter **902** and a flexible datacenter **500**, according to one or more example embodiments. The arrangement of FIG. **9** includes a flexible datacenter **500**, a traditional datacenter **902**, a queue system **312**, a set of communication links **916**, **918**, **920**A, **920**B, and the remote master control system **300**. The arrangement of FIG. **9** represents an example configuration scheme that can be used to distribute computing operations using a queue system **312** between the traditional datacenter **902** and one or more flexible datacenters. In other examples, the arrangement of FIG. **9** may include more or fewer components in other potential configurations. For instance, the arrangement of FIG. **9** may not include the queue system **312** or may include routes that bypass the queue system **312**.

The arrangement of FIG. **9** may enable computational operations requested to be performed by entities (e.g., companies). As such, the arrangement of FIG. **9** may use the queue system **312** to organize incoming computational operations requests to enable efficient distribution to the flexible datacenter **500** and the critical traditional datacenter **902**. Particularly, the arrangement of FIG. **9** may use the queue system **312** to organize sets of computational operations thereby increasing the speed of distribution and performance of the different computational operations among datacenters. As a result, the use of the queue system **312** may reduce time to complete operations and reduce costs.

In some examples, one or more components, such as the datacenter control system **504**, the remote master control system **300**, the queue system **312**, or the control system **936**, may be configured to identify situations that may arise where using the flexible datacenter **500** can reduce costs or increase productivity of the system, as compared to using the traditional datacenter **902** for computational operations. For example, a component within the arrangement of FIG. **9** may identify when using behind-the-meter power to power the computing systems **512** within the flexible datacenter **500** is at a lower cost compared to using the computing systems **934** within the traditional datacenter **902** that are powered by grid power. Additionally, a component in the arrangement of FIG. **9** may be configured to determine situations when offloading computational operations from the traditional datacenter **902** indirectly (i.e., via the queue system **312**) or directly (i.e., bypassing the queue system **312**) to the flexible datacenter **500** can increase the performance allotted to the computational operations requested by an entity (e.g., reduce the time required to complete time-sensitive computational operations).

In some examples, the datacenter control system **504** may monitor activity of the computing systems **512** within the flexible datacenter **500** and use the respective activity levels to determine when to obtain computational operations from the queue system **312**. For instance, the datacenter control system **504** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **512** to perform. The various factors may include power availability at the flexible datacenter **500** (e.g., either stored or from a BTM source), availability of the computing systems **512** (e.g., percentage of computing systems available), type of computational operations available, estimated cost to perform the computational operations at the flexible datacenter **500**, cost for power, cost for power relative to cost for grid power, and instructions from other components within the system, among others. The datacenter control system **504** may analyze one or more of the factors when determining whether to obtain a new set of computational operations for the computing systems **512** to perform. In such a configuration, the datacenter control system **504** manages the activity of the flexible datacenter **500**, including determining when to acquire new sets of computational operations when capacity among the computing systems **512** permit.

In other examples, a component (e.g., the remote master control system **300**) within the system may assign or distribute one or more sets of computational operations organized by the queue system **312** to the flexible datacenter **500**. For example, the remote master control system **300** may manage the queue system **312**, including the distribution of computational operations organized by the queue system **312** to the flexible datacenter **500** and the traditional datacenter **902**. The remote master control system **300** may utilize to information described with respect to the Figures above to determine when to assign computational operations to the flexible datacenter **500**.

The traditional datacenter **902** may include a power input system **930**, a power distribution system **932**, a datacenter control system **936**, and a set of computing systems **934**. The power input system **930** may be configured to receive power from a power grid and distribute the power to the computing systems **934** via the power distribution system **932**. The datacenter control system **936** may monitor activity of the computing systems **934** and obtain computational operations to perform from the queue system **312**. The datacenter control system **936** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **934** to perform. A component (e.g., the remote master control system **300**) within the arrangement of FIG. **9** may assign or distribute one or more sets of computational operations organized by the queue system **312** to the traditional datacenter **902**.

The communication link **916** represents one or more links that may serve to connect the flexible datacenter **500**, the traditional datacenter **902**, and other components within the system (e.g., the remote master control system **300**, the queue system **312**—connections not shown). In particular, the communication link **916** may enable direct or indirect communication between the flexible datacenter **500** and the traditional datacenter **902**. The type of communication link **916** may depend on the locations of the flexible datacenter **500** and the traditional datacenter **902**. Within embodiments, different types of communication links can be used, including but not limited to WAN connectivity, cloud-based connectivity, and wired and wireless communication links.

The queue system **312** represents an abstract data type capable of organizing computational operation requests received from entities. As each request for computational operations are received, the queue system **312** may organize the request in some manner for subsequent distribution to a datacenter. Different types of queues can make up the queue system **312** within embodiments. The queue system **312** may be a centralized queue that organizes all requests for computational operations. As a centralized queue, all incoming requests for computational operations may be organized by the centralized queue.

In other examples, the queue system **312** may be distributed consisting of multiple queue sub-systems. In the distributed configuration, the queue system **312** may use multiple queue sub-systems to organize different sets of computational operations. Each queue sub-system may be used to organize computational operations based on various factors, such as according to deadlines for completing each set of computational operations, locations of enterprises submitting the computational operations, economic value associated with the completion of computational operations, and quantity of computing resources required for performing each set of computational operations. For instance, a first queue sub-system may organize sets of non-intensive computational operations and a second queue sub-system may organize sets of intensive computational operations. In some examples, the queue system **312** may include queue sub-systems located at each datacenter. This way, each datacenter (e.g., via a datacenter control system) may organize computational operations obtained at the datacenter until computing systems are able to start executing the computational operations. In some examples, the queue system **312** may move computational operations between different computing systems or different datacenters in real-time.

Within the arrangement of FIG. **9**, the queue system **312** is shown connected to the remote master control system **300** via the communication link **918**. In addition, the queue system **312** is also shown connected to the flexible datacenter via the communication **920**A and to the traditional datacenter **902** via the communication link **920**B. The communication links **918**, **920**A, **920**B may be similar to the communication link **916** and can be various types of communication links within examples.

The queue system **312** may include a computing system configured to organize and maintain queues within the queue system **312**. In another example, one or more other components of the system may maintain and support queues within the queue system **312**. For instance, the remote master control system **300** may maintain and support the queue system **312**. In other examples, multiple components may maintain and support the queue system **312** in a distributed manner, such as a blockchain configuration.

In some embodiments, the remote master control system **300** may serve as an intermediary that facilitates all communication between flexible datacenter **500** and the traditional datacenter **902**. Particularly, the traditional datacenter **902** or the flexible datacenter **500** might need to transmit communications to the remote master control system **300** in order to communicate with the other datacenter. As also shown, the remote master control system **300** may connect to the queue system **312** via the communication link **918**. Computational operations may be distributed between the queue system **312** and the remote master control system **300** via the communication link **918**. The computational operations may be transferred in real-time and mid-performance from one datacenter to another (e.g., from the traditional datacenter **902** to the flexible datacenter **500**). In addition, the remote master control system **300** may manage the queue system **312**, including providing resources to support queues within the queue system **312**.

As a result, the remote master control system **300** may offload some or all of the computational operations assigned to the traditional datacenter **902** to the flexible datacenter **500**. This way, the flexible datacenter **500** can reduce overall computational costs by using the behind-the-meter power to provide computational resources to assist traditional datacenter **902**. The remote master control system **300** may use the queue system **312** to temporarily store and organize the offloaded computational operations until a flexible datacenter (e.g., the flexible datacenter **500**) is available to perform them. The flexible datacenter **500** consumes behind-the-meter power without transmission or distribution costs, which lowers the costs associated with performing computational operations originally assigned to the traditional datacenter **902**. The remote master control system **300** may further communicate with the flexible datacenter **500** via communication link **922** and the traditional datacenter **902** via the communication link **924**.

FIG. **10**A shows method **1000** of dynamic power consumption at a flexible datacenter using behind-the-meter power according to one or more example embodiments. Other example methods may be used to manipulate the power delivery to one or more flexible datacenters.

In step **1010**, the datacenter control system, the remote master control system, or another computing system may monitor behind-the-meter power availability. In some embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1020**, the datacenter control system or the remote master control system **300** may determine when a datacenter ramp-up condition is met. In some embodiments, the datacenter ramp-up condition may be met when there is sufficient behind-the-meter power availability and there is no operational directive from the generation station to go offline or reduce power.

In step **1030**, the datacenter control system may enable behind-the-meter power delivery to one or more computing systems. In some instances, the remote mater control system may directly enable BTM power delivery to computing systems within the flexible system without instructing the datacenter control system.

In step **1040**, once ramped-up, the datacenter control system or the remote master control system may direct one or more computing systems to perform predetermined computational operations. In some embodiments, the predetermined computational operations may include the execution of one or more distributed computing processes, parallel processes, and/or hashing functions, among other types of processes.

While operational, the datacenter control system, the remote master control system, or another computing system may receive an operational directive to modulate power consumption. In some embodiments, the operational directive may be a directive to reduce power consumption. In such embodiments, the datacenter control system or the remote master control system may dynamically reduce power delivery to one or more computing systems or dynamically reduce power consumption of one or more computing systems. In other embodiments, the operational directive may be a directive to provide a power factor correction factor. In such embodiments, the datacenter control system or the remote master control system may dynamically adjust power delivery to one or more computing systems to achieve a desired power factor correction factor. In still other embodiments, the operational directive may be a directive to go offline or power down. In such embodiments, the datacenter control system may disable power delivery to one or more computing systems.

FIG. **10**B shows method **1050** of dynamic power delivery to a flexible datacenter using behind-the-meter power according to one or more embodiments. In step **1060**, the datacenter control system or the remote master control system may monitor behind-the-meter power availability. In

certain embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1070**, the datacenter control system or the remote master control system may determine when a datacenter ramp-down condition is met. In certain embodiments, the datacenter ramp-down condition may be met when there is insufficient behind-the-meter power availability or anticipated to be insufficient behind-the-meter power availability or there is an operational directive from the generation station to go offline or reduce power.

In step **1080**, the datacenter control system may disable behind-the-meter power delivery to one or more computing systems. In step **1090**, once ramped-down, the datacenter control system remains powered and in communication with the remote master control system so that it may dynamically power the flexible datacenter when conditions change.

One of ordinary skill in the art will recognize that a datacenter control system may dynamically modulate power delivery to one or more computing systems of a flexible datacenter based on behind-the-meter power availability or an operational directive. The flexible datacenter may transition between a fully powered down state (while the datacenter control system remains powered), a fully powered up state, and various intermediate states in between. In addition, flexible datacenter may have a blackout state, where all power consumption, including that of the datacenter control system is halted. However, once the flexible datacenter enters the blackout state, it will have to be manually rebooted to restore power to datacenter control system. Generation station conditions or operational directives may cause flexible datacenter to ramp-up, reduce power consumption, change power factor, or ramp-down.

FIG. **11** illustrates a block diagram of a system for implementing control strategies based on a power option agreement, according to one or more embodiments. The system **1100** represents an example arrangement that includes a control system (e.g., the remote master control system **262**), a load (e.g., one or more of the datacenters **1102**, **1104**, and **1106**), and a power entity **1140**, which may establish and operate in accordance with a power option agreement. Additional arrangements are possible within examples.

In general, a power option agreement is an agreement between a power entity **1140** associated with the delivery of power to a load (e.g., a grid operator, power generation station, or local control station) and the load (e.g., the datacenters **1102-1106**). As part of the power option agreement, the load (e.g., load operator, contracting agent for the load, semi-automated control system associated with the load, and/or automated control system associated with the load) provides the power entity **1140** with the right, but not obligation, to reduce the amount of power delivered (e.g., grid power) to the load up to an agreed amount of power during an agreed upon time interval. In order to provide the power entity **1140** with this option, the load needs to be using at least the amount of power subject to the option (e.g., a minimum power threshold). For instance, the load may agree to use at least 1 MW of grid power at all times during a specified 24-hour time interval to provide the power entity **1140** with the option of being able to reduce the amount of power delivered to the load by any amount up to 1 MW at any point during the specified 24-hour time interval. The load may grant the power entity **1140** with this option in exchange for a monetary consideration (e.g., receive power at a reduced price and/or monetary payment if the option is exercised by the power entity).

The power option agreement may be used by the power entity **1140** to reserve the right to reduce the amount of grid power delivered to the load during a set time frame (e.g., the next 24 hours). For instance, the power entity **1140** may exercise a predefined power option to reduce the amount of grid power delivered to the load during a time when the grid power may be better redirected to other loads coupled to the power grid. As such, the power entity **1140** may exercise power option agreements to balance loads coupled to the power grid. In some embodiments, a power option agreement may also specify other parameters, such as costs associated with different levels of power consumption and/or maximum power thresholds for the load to operate according to.

To illustrate an example, a power option agreement may specify that a load (e.g., the datacenters **1102-1106**) is required to use at least 10 MW or more at all times during the next 12 hours. Thus, the minimum power threshold according to the power option agreement is 10 MW and this minimum power threshold extends across the time interval of the next 12 hours. In order to comply with the agreement, the load must subsequently operate using 10 MW or more power at all times during the next 12 hours. This way, the load can accommodate a situation where the power entity **1140** exercises the option. Particularly, exercising the option may trigger the load to reduce the amount of power it consumes by an amount up to 10 MW at any point during the 12 hour interval. By establishing this power option agreement, the power entity **1140** can manipulate the amount of power consumed at the load during the next 12 hours by up to 10 MW if power needs to be redirected to another load or a reduction in power consumption is needed for other reasons.

In the example arrangement of the system **1100** shown in FIG. **11**, one or more of the datacenters (e.g., the flexible datacenters **1102**, **1104**, and the traditional datacenter **1106**) may operate as the load that is subject to a power option agreement. As the load that is subject to the power option agreement, the datacenters **1102-1106** may execute control instructions in accordance with power target consumption targets that meet or exceed the minimum power thresholds based on the power option agreement.

As shown in FIG. **11**, each datacenter **1102-1106** may include a set of computing systems configured to perform computational operations using power from one or more power sources (e.g., BTM power, grid power, and/or grid power subject to a power option agreement). In particular, the flexible datacenter **1102** includes computing systems **1108** arranged into a first set **1114**A, a second set **1114**B, and a third set **1114**C, the flexible datacenter **1104** includes computing systems **1110** arranged into a first set **1116**A, a second set **1116**B, and a third set **1118**B, and the traditional datacenter **1106** includes computing systems **1112** arranged into a first set **1118**A, a second set **1118**B, and a third set **1118**C. Each set of computing systems may include various types of computing systems that can operate in one or more modes.

The different sets of computing systems as well as the multiple datacenters are included in FIG. **11** for illustration purposes. In particular, the variety of computing systems represent different configurations that a load may take while operating in accordance with a power option agreement, and each configuration (as detailed herein) may include ramping up or down power consumption and transferring and performing computational operations between sets of comput-

ing systems and/or datacenters. In other examples, the load that is subject to a power option agreement may take on other configurations (e.g., a single datacenter **1102-1106**, and/or a single set of computing systems).

The remote master control system **262** may serve as a control system that can determine performance strategies and provide control instructions to the load (e.g., one or more of the datacenters **1102-1106**). In particular, the remote master control system **262** can monitor conditions in concert with the minimum power thresholds and time intervals (e.g., power option data) set forth in, and/or derived from, one or more power option agreements to determine performance strategies that can enable the load to meet the expectations of the power option agreement(s) while also efficiently using power to accomplish computational operations. In some instances, the remote master control system **262** may also be subject to the power option agreement and may adjust its own power consumption based on the power option agreement (e.g., ramp up or down power consumption based on the defined minimum power thresholds during time intervals).

To establish a power option agreement, the remote master control system **262** (or another computing system) may communicate with the power entity **1140**. For instance, the remote master control system **262** may provide a request (e.g., a signal and/or a bid) to the power entity **1140** and receive the terms of one or more power option agreements, or power option data related to power option agreements (e.g., data such as minimum power thresholds and time intervals, but not all terms contained within a potential power option agreement) in response. In some examples, the remote master control system **262** may evaluate one or more conditions prior to establishing a power option agreement to ensure that the conditions could enable the load (e.g., the datacenters **1102-1106**) to operate in accordance with the power option agreement. For instance, the remote master control system **262** may check the quantity and deadlines associated with computational operations assigned to specific datacenters prior to establishing specific datacenters as a load subject to a power option agreement. In some cases, multiple power option agreements may be established. For example, each datacenter **1102-1106** may be subject to a different power option agreement, which may result in the remote master control system **262** managing the power consumption at each of the datacenters **1102-1106** differently.

Within the system **1100** shown in FIG. **11**, the power entity **1140** may represent any type of power entity associated with the delivery of power to the load that is subject to a power option agreement. For instance, the power entity **1140** may be a local station control system, a grid operator, or a power generation source. As such, the power entity **1140** may establish power option agreements with the loads via communication with the loads and/or the remote master control system **262**. For example, the power entity **1140** may obtain and accept a bid from a load trying to engage in a power option agreement with the power entity **1140**. The power entity **1140** is shown with a power option module **1142**, which may be used to establish power option agreements (e.g., fixed-duration 1144 and/or dynamic **1146**).

Once a power option agreement is established, the remote master control system **262** may obtain power option data from the power entity **1140** (or another source) that specifies the power and time expectations of the power entity **1140**. As shown in FIG. **11**, the power entity **1140** includes a power option module **1142**, which may be used to provide power option data to the remote master control system **262** and/or

the datacenters **1102-1106**. In particular, the power option data may specify the minimum power threshold or thresholds associated with one or more time intervals for the load to operate at in accordance with based on the power option agreement. The power option data may also specify other constraints that the load should operate in accordance with.

In some examples, the power option data may also include an indication of a monetary penalty that would be imposed upon the load for failure to operate as agreed upon for the power option agreement. In addition, the power option data may also include an indication of a monetary benefit provided to the load operating at power consumption levels that are in accordance with a power option agreement. For instance, monetary benefits could include reduced prices for power, credits for power, and/or monetary payments. In addition, the power option data may include further constraints upon power use, such as one or more maximum power thresholds and corresponding time intervals for the maximum power thresholds.

In some embodiments, the power entity **1140** may correspond to a qualified scheduling entity (QSE). A QSE may submit bids and offers on behalf of resource entities (REs) or load serving entities (LSEs), such as retail electric providers (REPs). QSEs may submit offers to sell and/or bids to buy power (energy) in the Day-Ahead Market (e.g., the next 24 hours) and the Real-Time Market. As such, the remote master control system **262** or another computing system may communicate with one or more QSEs to engage and control one or more loads in accordance with one or more power option agreements.

In some examples, a power option agreement may take the form of a fixed duration power option agreement **1144**. The fixed duration power option agreement **1144** may specify a set of minimum power thresholds and a set of time intervals in advance for an upcoming fixed duration of time covered by the agreement. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. Examples of such association are provided in FIG. **12**. The fixed duration power option agreement may be established in advanced of the time period covered by the set of time intervals to enable the remote master control system **262** to prepare performance strategies for the load (e.g., the datacenter(s)) associated with the power option agreement. Thus, the remote master control system **262** may evaluate the fixed duration power option and other monitored conditions to determine performance strategies for a set of computing systems (e.g., one or more datacenters) during the different intervals that satisfy the minimum power thresholds.

In other examples, a power option agreement may take the form of a dynamic power option agreement **1146**. For a dynamic power option agreement **1146**, minimum power thresholds may be provided to the remote master control system **262** in real-time (or near real-time). For instance, a dynamic power option agreement may specify that the power entity **1140** may provide adjustments to minimum power thresholds and corresponding time intervals in real-time to the remote master control system **262**. For example, a dynamic power option agreement may provide power option data that specifies a minimum power threshold for immediate adjustments (e.g., for the next hour).

In an embodiment, a dynamic power option agreement **1146** may involve repeat communication between the remote master control system **262** and the power entity **1140**. Particularly, the power entity **1140** may provide signals to the remote master control system **262** that request power consumption adjustments to be initiated at one or more

datacenters by the remote master control system **262** over short time intervals, such as across minutes or seconds. For example, the power entity **1140** may communicate to the remote master control system **262** to ramp power consumption down to a particular level within the next 5 minutes. As a result, the remote master control system **262** may provide instructions to one or more datacenters to ramp down power consumption using a linear ramp over the next 5 minutes to meet the particular level specified by the power entity **1140**. The remote master control system **262** may monitor the linear ramp down of power consumption and increase or decrease the rate that the datacenter(s) ramp down power use based on projections and updates received from the power entity **1140**. As a result, although the ramp down of power consumption may initially be performed in a linear manner to meet a power target threshold, the remote master control system **262** may adjust the rate of power consumption decrease based on updates from the power entity **1140**. For example, 25 percent of the overall power consumption ramp down may occur during a first period (e.g., 4 minutes 30 seconds) of the 5 minutes and the remaining 75 percent of the overall power consumption ramp down may occur during the remaining period of the 5 minutes (e.g., the final 30 seconds). The example percentages are included for illustration purposes and can vary within examples based on various parameters, such as additional communication (e.g., adjustments) provided by the power entity **1140**.

In further examples, a power option agreement may operate similarly to both a fixed-duration 1144 and a dynamic power option agreement **1146**. Particularly, power option data specifying minimum power thresholds and corresponding time intervals may be provided in advance for the entire fixed-duration of time (e.g., the next 24 hours). Additional power option data may then be subsequently provided enabling the remote master control system **262** to make one or more adjustments to accommodate any changes specified within the additional power option data. For instance, additional power option data may indicate that a power entity exercised its option to deliver less power to the load. As a result, the remote master control system may instruct the load to adjust power consumption based on the power entity reducing the power threshold minimum via exercising the option.

As indicated above, the remote master control system **262** may monitor conditions in addition to the constraints set forth in power option data received from the power entity **1140**. Particularly, the remote master control system **262** may monitor and analyze a set of conditions (including the power option data) to determine strategies for assigning, transferring, and otherwise managing computational operations using the one or more datacenters **1102-1106**. The determined strategies may enable efficient operation by the datacenters while also ensuring that the datacenters operate at target power consumption levels that meet or exceed the minimum power thresholds set forth within one or more power option agreements.

Example monitored conditions include, but are not limited to, power availability **1120**, power prices **1122**, computing systems parameters **1124**, cryptocurrency prices **1126**, computational operation parameters **1128**, and weather conditions **1129**. Power availability **1120** may include determining power consumption ranges at a set of computing systems and/or at one or more datacenters. In addition, power availability **1120** may also involve determining the source or sources of power available at a datacenter. For instance, the remote master control system **262** may identify the types of power sources (e.g., BTM, grid power, and/or a battery system) that a datacenter has available. Power prices **1122** may involve an analysis of the different costs associated with powering a set of computing systems. For instance, the remote master control system **262** may determine cost of power from the grid without a power option agreement relative to the cost power from the grid under the power option agreement. In addition, the remote master control system **262** may also compare the cost of grid power relative to the cost of BTM power when available at a datacenter. The power prices **1122** may also involve comparing the cost of using power at different datacenters to determine which datacenter may perform computational operations at a lower cost.

Monitoring computing system parameters **1124** may involve determining parameters related to the computing systems at one or more datacenters. For instance, the remote master control system **262** may monitor various parameters of the computing systems at a datacenter, such as the abilities and availability of various computing systems, the status of the queue used to store computational operations awaiting performance by the computing systems. The remote master control system **262** may determine types and operation modes of the computing systems, including which computing systems could operate in different modes (e.g., a higher power or a lower power mode) and/or at different hash rates and/or frequencies. The remote master control system **262** may also estimate when computing systems may complete current computational operations and/or how many computational operations are assigned to computing systems.

Monitoring cryptocurrency prices **1126** may involve monitoring the current price of one or more cryptocurrencies, the hash rate and/or estimated power consumption associated with mining each cryptocurrency, and other factors associated with the cryptocurrencies. The remote master control system **262** may use data related to monitoring cryptocurrency prices **1126** to determine whether using computing systems to mine a cryptocurrency generates more revenue than the cost of power required for performance of the mining operations.

The remote master control system **262** may monitor parameters related to computational operations (e.g., computational operation parameters **1128**). For example, the remote master control system **262** may monitor parameters related to the computational operations requiring performance and currently being performed, such quantity of operations, estimated time to complete, cost to perform each computational operation, deadlines and priorities associated with each computational operation. In addition, the remote master control system **262** may analyze computational operations to determine if a particular type of computing system may perform the computational operation better than other types of computing systems.

Monitoring weather conditions **1129** may include monitoring for any potential power generation disruption due to emergencies or other events, and changes in temperatures or weather conditions at power generators or datacenters that could affect power generation. As such, the operations and environment analysis module (or another component) of the remote master control system **262** may be configured to monitor one or more conditions described above.

The performance strategy determined by the remote master control system **262** based on the monitored conditions and/or power option data can include control instructions for the load (e.g., the datacenters and/or one or more sets of computing systems). For instance, a performance strategy can specify operating parameters, such as operating frequen-

cies, power consumption targets, operating modes, power on/off and/or standby states, and other operation aspects for computing systems at a datacenter.

The performance strategy can also involve aspects related to the assignment, transfer, and performance of computational operations at the computing systems. For instance, the performance strategy may specify computational operations to be performed at the computing systems, an order for completing computational operations based on priorities associated with the computational operations, and an identification of which computing systems should perform which computational operations. In some instances, priorities may depend on revenue associated with completing each computational operation and deadlines for each computational operation.

The monitored conditions may enable efficient distribution and performance of computational operations among computing systems at one or more datacenters (e.g., datacenters **1102-1106**) in ways that can reduce costs and/or time to perform computational operations, take advantage of availability and abilities of computing systems at the datacenters **1102-1106**, and/or take advantage in changes in the cost for power at the datacenters **1102-1106**. In addition, the monitored conditions may also involve consideration of the power option data to ensure that the computing systems consume enough power to meet minimum power thresholds set forth in one or more power option agreements.

The various monitored conditions described above as well as other potential conditions may change dynamically and with great frequency. Thus, to enable efficient distribution and performance of the computational operations at the datacenters, the remote master control system **262** may be configured to monitor changes in the various conditions to assist with the efficient management and operations of the computing systems at each datacenter. For instance, the remote master control system **262** may engage in wired or wireless communication **1130** with datacenter control systems (e.g., datacenter control system **504**) at each datacenter as well as other sources (e.g., the power entity **1140**) to monitor for changes in the conditions.

The remote master control system **262** may analyze the different conditions in real-time to modulate operating attributes of computing systems at one or more of the datacenters. By using the monitored conditions, the remote master control system **262** may increase revenue, decrease costs, and/or increase performance of computational operations via various modifications, such as transferring computational operations between datacenters or sets of computing systems within a datacenter and adjusting performance at one or more sets of computing systems (e.g., switching to a low power mode).

In some examples, the traditional datacenter **1106** may be the load subject to a power option agreement. As such, the remote master control system **262** may factor the power option agreement when determining whether to perform computational operations using the computing systems **1112** at the traditional datacenter **1106** and/or transfer computational operations to the computing systems **1108**, **1110** at the flexible datacenters **1102**, **1104**. For instance, the monitored conditions may indicate that the price of grid power is substantially higher than BTM power. As a result, the remote master control system **262** may transfer a subset of computational operations from the traditional datacenter **1106** to the flexible datacenters **1102**, **1104**. The traditional datacenter **1106** may still have some computational operations to perform to ensure that the traditional datacenter **1106** is using enough power to meet the minimum power threshold or thresholds set forth in the power option agreement.

In some examples, the remote master control system **262** may monitor the grid frequency signal received from the power entity **1140**. When the frequency of the grid deviates a threshold amount (e.g., 0.036 Hz above or below 60 Hz), the remote master control system **262** may adjust performance strategies at the load. In some cases, the remote master control system **262** may adjust the power consumption at the load, the number of miners (or computing systems) operating at the load, and/or the frequency or hash rate, among other possible changes. The remote master control system may readjust performance strategies at the load in response to receiving additional power option data from the power entity **1140** (e.g., an indication that the frequency of the grid is back to 60 Hz). In addition, the remote master control system **262** may communicate changes in operations at the load to the power entity **1140**. This way, the power entity **1140** may obtain confirmation that the load is adjusting in accordance with a power option agreement.

In some embodiments, a power generation source (e.g., the generation station **400** shown in FIG. **4**) may enter into a power option agreement with a grid operator, which may provide the grid operator with the option to reduce the amount of power that the power source generator can deliver to the grid during a defined time interval. For instance, a wind generation farm may enter into the power option agreement with the grid operator. In addition, the remote master control system **262** may also enter into a power option agreement with the power generation source (e.g., the wind farm) to provide a load that can receive excess power from the power generation source when the grid operator exercises the option and lowers the amount of power that the power generation source can deliver to the grid. Thus, rather than reducing the amount of power produced, the power generation source could exercise an option in the agreement with remote master control system **262** and redirect excess power to one or more loads (e.g., a set of computing systems) that could ramp up power consumption in response. In such situations, the remote master control system **262** maybe able to use the excess power from the power generation source (e.g., BTM power) to perform operations at one or more loads at a low cost (or no cost at all). In addition, the power generation source may benefit from the power option agreement by directing excess power to the load instead of temporarily halting power production.

In some examples, a power option agreement may depend on parameters associated balancing grid capacity and demand. For instance, power option agreements may incentivize power consumption ramping during periods of peak grid power use.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments. The graph **1200** shows power option data arranged according to power **1204** over time **1202**. As shown in FIG. **12**, time **1202** increases along the X-axis and minimum power thresholds **1204** increase along the Y-axis of the graph **1200**. In the example embodiment shown in FIG. **12**, the time **1202** increases up to a full day (e.g., 24 hours) in 4 hour increments and the power is shown in MW increasing in intervals of 5 MW. The 24 duration and example minimum power thresholds can differ in other embodiments. Particularly, these values may depend on the terms set forth within the power option agreement.

The graph line **1206** represents sets of minimum power thresholds **1206**A, **1206**B, **1206**C that are specified by

power option data based on the power option agreement. As shown, the graph line **1206** extends the entire 24 hour duration, which indicates that the set of time intervals associated with minimum power thresholds add up to 24 hours. In other examples, the power option agreement may not include a minimum power threshold during a portion of the duration.

The graph line **1206** of the graph **1200** is further used to illustrate power consumption levels that one or more loads (e.g., a set of computing systems) operating according to the power option agreement may utilize during the 24 hour duration. Particularly, the power quantities above the graph line **1206** represents power levels that the load(s) may consume from the power grid during the 24 hour duration that would satisfy the requirements (i.e., the minimum power thresholds **1206**A-**1206**C) set forth by the power option agreement. In particular, the power quantities above the graph line **1206** include any power quantity that meets or exceeds the minimum power threshold at that time. By extension, the power quantities positioned below the graph line **1206** represents the amount of power that the load could be directed to reduce power consumption by per the power option agreement.

To further illustrate, an initial minimum power threshold **1206**A is shown associated with the time interval starting at hour 0 and extending to hour 8. In particular, the minimum power threshold **1206**A is set at 5 MW during this time interval. Thus, based on the power option data shown in FIG. **12**, the loads must be able to operate at a target power consumption level that is equal to or greater than the 5 MW minimum power threshold **1206**A at all times during the time interval extending from hour 0 to hour 8, in order to be able to satisfy the power option if it is exercised for that time interval. Similarly, the power entity could reduce the power consumed by loads by any amount up to 5 MW at any point during the time interval from hour 0 to hour 8 in accordance with the power option agreement. For instance, the power entity could exercise its option at any point during this time interval to reduce the power consumed by the loads by 3 MW as a way to load balance the power grid. In response to the power entity exercising its option, the load may then operate using 3 MW less power and/or another strategy determined by a control system factoring additional conditions (e.g., the price of grid power, the revenue that could be generated from mining a cryptocurrency, and/or parameters associated with computational operations awaiting performance)

As further shown in the graph **1200** illustrated in FIG. **12**, the next minimum power threshold **1206**B is associated with the following time interval, which starts at hour 8 and extends until hour 16. During this time interval (hour 8 to hour 16), the load(s) may consume 10 MW or more power since the minimum power threshold **1206**B is now set at 10 MW as shown on the Y-axis of the graph **1200**. In light of the power option data, a control system may determine and provide a performance strategy to the load (e.g., a set of computing systems) that includes a power consumption target that meets or exceeds the minimum power threshold **1206**B (i.e., 10 MW). The performance strategy may depend on the power option data as well as other possible conditions, such as the price of grid power, the availability of computing systems, and/or the type of computing operations, etc. In addition, the power entity could exercise its option to reduce the amount of power consumed by the load by 10 MW or less as represented by the power levels under the minimum threshold **1206**B that extend during the time interval of hour 8 to hour 16.

The last minimum power threshold **1206**C is associated with the time interval that starts at hour 16 and extends until hour 24. Similar to the initial minimum power threshold **1206**A associated with the beginning of the graph line **1206**, the last minimum power threshold **1206** is also set at 5 MW. As such, at any point during this interval (hour 16 to hour 24) the loads may consume 5 MW or more to operate in accordance with the power option agreement. As discussed above, by operating at 5 MW or more, the load enables the power consumed from the power grid to be reduced any amount from zero up to 5 MW during this time interval.

When determining the power consumption strategy for a load, a computing system (e.g., the remote master control system **262**) may consider various conditions in addition to the power option data received based on one or more power option agreements. Particularly, the computing system may consider and weigh different conditions in addition to the power option data to determine power consumption targets and/or other control instructions for a load. The conditions may include, but are not limited to, the price of grid power, the price of alternative power sources (e.g., BTM power, stored energy), the revenue associated with mining for one or more cryptocurrencies, parameters related to the computational operations requiring performance (e.g., priorities, deadlines, status of the queue organizing the operations, and/or revenue associated with completing each computational operation), parameters related to the set of computing systems (e.g., types and availabilities of computing systems), and other conditions (e.g., penalties if a minimum power threshold is not met and/or monetary benefits from operating under a power option agreement). By weighing various conditions, the computing system may efficiently manage the set of computing systems, including enabling performance of computational operations cost effectively and/or ensuring at that computing systems operate at target power consumption levels that one or more satisfy power option agreements.

In some examples, the computing system may decrease the amount of power that a set of computing systems consumes from one source and while also increasing the amount of power that the set consumes from another source. For instance, the computing system may determine that the price of power grid power is above a threshold price that makes computational operations relatively expensive to perform using grid power. As a result, the computing system may provide control instructions for the computing systems to consume power grid power that matches a minimum power threshold specified by power option data. This may enable the computing systems to satisfy the power option agreement while also avoiding using pricey grid power beyond the minimum amount required per the power option data. In addition, the computing system may instruct some computing systems to switch to a low power mode or temporarily stop until the price of power from the grid decreases. The computing system may instruct one or more computing systems to operate using power from another source (e.g., BTM power and/or stored energy from a battery system) and/or transfer one or more computational operations to another set of computing systems (e.g., a different datacenter).

When the power option agreement is a fixed duration power option agreement, the computing system may receive an indication of all the minimum power thresholds **1206**A-**1206**C and an indication of the associated time interval altogether and in advance of the duration associated with the power option agreement. By providing all of the minimum power thresholds **1206**A-**1206**C and the time intervals in

advance, the computing system may determine a performance strategy for the load that can extend across the entire duration. Particularly, the computing system may factor the minimum power thresholds and associated time intervals as well as other monitored conditions to determine the performance strategy for the total duration. This can enable the computing system to accept and assign computational operations to computing systems in advance while also using a performance strategy that meets the expectations of a power option agreement.

In some examples, the performance strategy determined by the computing system may include control instructions for the set of computing systems to execute if a power option is exercised. For instance, the performance strategy may specify different power consumption targets for the computing systems that depend on whether a power option is exercised during each time interval.

In some instances, the computing system may modify the performance strategy when one or more conditions change enough to warrant a modification. For instance, the computing system may receive an indication of a change in a minimum power threshold (e.g., a decrease in the minimum power threshold) and determine one or more modifications based on the new minimum power threshold and/or other conditions (e.g., a change in the price of power).

In other examples, the power option agreement may be a dynamic power option agreement. Particularly, the load may be subject to a changing minimum power threshold that can vary during a predefined duration associated with the power option agreement. For example, a dynamic power option agreement may specify that the load is subject to a minimum power threshold that may vary from 0 MW up to 5 MW during the next 24 hours and the particular minimum threshold for each hour may depend on power option data received from the power entity during the prior hour. The dynamic power option agreement may further specify the expected response time from the load. For instance, the power option agreement may indicate that an indication of a new minimum power threshold will be provided an hour prior to the start of the minimum power threshold. The computing system, for example, may receive an indication at hour 7 about the increase in the minimum power threshold **1206**B starting at hour 8. The indication may (or may not) specify the total time interval associated with a new minimum power threshold. For instance, the indication received by the computing system may specify that the 10 MW minimum power threshold **1206**B extends from hour 8 until hour 16. In other instances, the power option data may indicate that the computing system should abide by the new minimum power threshold until receiving further power option data indicating a change to another new minimum power threshold.

In some examples, the power option data may arrive at the computing system in an unknown order from the power entity with expectations of swift power consumption adjustments by the load. As a result, the power option agreement may require fast ramping of the load to meet changes. Ramping may involve ramping up or down power consumption as well as ramping operating techniques (e.g., adjusting frequency or operation mode).

In some embodiments, the type of power option power agreement may depend on the delivery and content of power option data provided to the load (or a control system controlling the load). For instance, a computing system may receive minimum power thresholds set across an entire duration associated with a power option agreement in advance when the power option agreement is a fixed-duration power option agreement. In other instances, the computing system may receive power option data dynamically and adjust operations in real-time (or near real-time). For instance, the computing system may receive a series of power option data that each specifies minimum power threshold changes during the duration set forth in the dynamic power option agreement. To illustrate an example, the computing system may receive power option data during hour 1 that specifies the minimum power threshold for hour 2, power option data during hour 2 that specifies the minimum power threshold for hour 3, and so on across the duration of the dynamic power option agreement.

In some examples, the minimum power threshold for a time interval may be zero during the duration of a power option agreement. As such, the load may use any amount of power from the power grid in accordance with the power option agreement, including no power at all during this time interval. When the price for power is high during this time frame, the load may ramp down power usage to zero MW to avoid paying the high price for power while still being in compliance with the power option agreement.

FIG. **13** illustrates a method for implementing control strategies based on a fixed-duration power option agreement, according to one or more embodiments. The method **1300** serves as an example and may include other steps within other embodiments. A control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1300**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At step **1302**, the method **1300** involves monitoring a set of conditions. For instance, a computing system (e.g., a control system) may monitor various conditions that could impact the performance of operations at one or more loads, including the power consumption targets at the loads. The set of monitored conditions may include a variety of information obtained from one or more external sources, such as one or more datacenters, databases, power generation stations, or types of sources.

Some example conditions include, but are not limited to, the price of grid power, the price and availability of alternative power options (e.g. BTM power, and/or stored energy), parameters of the load (e.g., ramping abilities, type of computing systems, operation modes, etc.), parameters of tasks to be performed using the power at the load (e.g., types, deadlines, priorities, and/or revenue associated with computational operations), availability of other computing systems and their associated costs, and/or revenue associated with mining a cryptocurrency. The computing system may monitor one or more of these conditions as well as others.

At step **1304**, the method **1300** involves receiving power option data based, at least in part, on a power option agreement. As discussed above, the computing system (e.g., a remote master control system) may engage in a power option agreement with a power entity. As a result, the computing system may control a load (e.g., a set of computing systems) in accordance with power thresholds and time intervals received from the power entity based on the power option agreement.

In some examples, the power option data may specify a set of minimum power thresholds and a set of time intervals. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. To illustrate an example, the power option data may specify a first minimum power threshold

associated with a first time interval and a second minimum power threshold associated with a second time interval, with the second time interval subsequent to the first time interval.

The set of time intervals may add up to the duration represented by the power option agreement. For instance, the total duration of the set of time intervals may correspond to a twenty-four hour period (e.g., the next day). In other examples, the power option agreement may span across a different duration (e.g., 12 hours). In additional embodiments, the power option data may specify other information, such as monetary incentives associated with parameters of the power option agreement and/or one or more maximum power thresholds.

At step **1306**, the method **1300** involves determining a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy may be determined responsive to receiving the power option data. In addition, the performance strategy may include a power consumption target for the set of computing systems for each time interval in the set of time intervals. In some examples, each power consumption target is equal to or greater than the minimum power threshold associated with each time interval.

As an example, the performance strategy may specify a first power consumption target for the set of computing systems for a first time interval such that the first power consumption target is equal to or greater than a first minimum power threshold associated with the first time interval and a second power consumption target for the set for a second time interval in a similar manner (i.e., the second power consumption target is equal to or greater than a second minimum power threshold).

In some examples, the performance strategy may include an sequence for the set of computing systems to follow when performing computational operations. The sequence, for example, may be based on priorities associated with the computational operations. In addition, the performance strategy may include one or more power consumption targets that are greater than the minimum power thresholds when the price of power from the power grid is below a threshold price during the time intervals associated with the minimum power thresholds.

The performance strategy may also involve transferring, delaying, or adjusting one or more computational operations performed at the set of computing systems. In addition, the performance strategy may involve adjusting operations at the computing systems. For instance, one or more computing systems may switch modes (e.g., operate at a higher frequency or switch to a low power mode).

In addition, the performance strategy may also specify power consumption targets for the set of computing systems to use if the power option is exercised during an interval. This way, the computing systems may continue to perform computational operations (or suspend performance) based on the power option being exercised.

At step **1308**, the method **1300** involves providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy. For example, the set of computing systems may operate according to the performance strategy to ensure that the minimum power thresholds are met during the defined time intervals based on the power option agreement.

Some examples may further involve receiving subsequent power option data based, at least in part, on the power option agreement. The subsequent power option data may specify to decrease one or more minimum power thresholds of the set of power thresholds. Responsive to receiving the subsequent power option data, the performance strategy for the set of computing systems may be modified based on a combination of at least a portion of the subsequent power option data and one or more conditions of the monitored conditions. The modified performance strategy may include one or more reduced power consumption targets for the set of computing systems. The amount of the reduction in a power consumption target may depend linearly with the amount that the corresponding minimum power threshold was reduced by. For instance, when a minimum power threshold for a time interval is reduced from 10 MW to 5 MW, the power consumption target for that time interval may be reduced from 10 MW to 5 MW. Instructions may be provided to the set of computing systems to perform computational operations based on the modified performance strategy.

FIG. **14** illustrates a method for implementing control strategies based on a dynamic power option agreement, according to one or more embodiments. The method **1400** serves as an example and may include other steps within other embodiments. Similar to the method **1400**, a control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1400**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At block **1402**, the method **1400** involves monitoring a set of conditions. Similar to block **1302** of the method **1300**, a computing system may monitor various conditions to determine instructions for controlling a set of computing systems.

At block **1404**, the method **1400** involves receiving first power option data based, at least in part, on a power option agreement while monitoring the set of conditions. The first power option data may specify a first minimum power threshold associated with a first time interval. For example, the first power option data may specify a minimum power threshold of 10 MW for the next hour, which may start in an hour or less.

The power option agreement may correspond to a dynamic power option agreement in some examples. When managing a load with respect to a dynamic power option agreement, a computing system may receive power option data specifying changes in minimum power thresholds that a load (e.g., the set of computing systems) may be designated to use in the near term (e.g., the next hour). For example, the computing system may receive power option data during each hour of the duration specified by a power option agreement that indicates a minimum power threshold for the next hour.

At block **1406**, the method **1400** involves providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition. The first control instructions may be provided responsive to receiving the first power option data.

The first control instructions may include a first power consumption target for the set of computing systems for the first time interval. Particularly, the first power consumption target may be equal to or greater than the first minimum power threshold associated with the first time interval. For example, the first power consumption target may be greater than the first minimum power threshold when a cost of power from the power grid is below a threshold price during the first time interval. In other instances, the first power consumption target may be equal to the first minimum power

threshold when the cost of power from the power grid is greater than the threshold price.

In some examples, control instructions may specify a sequence for the computing systems to follow when performing computational operations. The sequence may be based on priorities associated with each computational operation.

The first control instructions may be determined based on a combination of the first power option data, the price of power from the power grid, and parameters associated with computational operations to be performed at the set of computing systems.

In some examples, the first control instructions may involve ramping up or down power consumption at the set of computing systems. The power consumption may be ramped up or down based on the first minimum power threshold and one or more other conditions (e.g., the price of power).

At block **1408**, the method **1400** involves receiving second power option data based, at least in part, on the power option agreement while monitoring the set of conditions. The computing system may receive the second power option data subsequent to receiving the first power option data. The second power option data may specify a second minimum power threshold associated with a second time interval. For example, the second minimum power threshold may be 7 MW over the duration of the upcoming hour. In other examples, the second minimum power threshold may differ as shown in FIG. **12**.

In some instances, the computing system may receive the second power option data during the first time interval such that the second time interval overlaps the first time interval. For instance, the computing system may receive the second power option data to enable real-time adjustments to be made to the power consumed at the set of computing systems.

At block **1410**, the method **1400** involves providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power option data and at least one condition. The second control instructions may be provided responsive to receiving the second power option data. The second control instructions may specify a second power consumption target for the set of computing systems for the second time interval. The second power consumption target may be equal to or greater than the second minimum power threshold associated with the second time interval.

In some examples, the computing system may provide a request to a QSE to determine the power option agreement. As such, the computing system may receive power option data (e.g., the first and second power option data) in response to providing the request to the QSE.

The computing system may monitor the price of power from the power grid, and the global mining hash rate and a price for a cryptocurrency (e.g., Bitcoin), among other conditions. The computing system may determine control instructions (e.g., the first and/or second control instructions) based on a combination of power option data, the price of power from the power grid, and the global mining hash rate and the price for the cryptocurrency. For instance, the computing system may cause one or more computing systems (e.g., a subset of computing systems) to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Advantages of one or more embodiments of the present invention may include one or more of the following:

One or more embodiments of the present invention provides a green solution to two prominent problems: the exponential increase in power required for growing blockchain operations and the unutilized and typically wasted energy generated from renewable energy sources.

One or more embodiments of the present invention allows for the rapid deployment of mobile datacenters to local stations. The mobile datacenters may be deployed on site, near the source of power generation, and receive low cost or unutilized power behind-the-meter when it is available.

One or more embodiments of the present invention provide the use of a queue system to organize computational operations and enable efficient distribution of the computational operations across multiple datacenters.

One or more embodiments of the present invention enable datacenters to access and obtain computational operations organized by a queue system.

One or more embodiments of the present invention allows for the power delivery to the datacenter to be modulated based on conditions or an operational directive received from the local station or the grid operator.

One or more embodiments of the present invention may dynamically adjust power consumption by ramping-up, ramping-down, or adjusting the power consumption of one or more computing systems within the flexible datacenter.

One or more embodiments of the present invention may be powered by behind-the-meter power that is free from transmission and distribution costs. As such, the flexible datacenter may perform computational operations, such as distributed computing processes, with little to no energy cost.

One or more embodiments of the present invention provides a number of benefits to the hosting local station. The local station may use the flexible datacenter to adjust a load, provide a power factor correction, to offload power, or operate in a manner that invokes a production tax credit and/or generates incremental revenue.

One or more embodiments of the present invention allows for continued shunting of behind-the-meter power into a storage solution when a flexible datacenter cannot fully utilize excess generated behind-the-meter power.

One or more embodiments of the present invention allows for continued use of stored behind-the-meter power when a flexible datacenter can be operational but there is not an excess of generated behind-the-meter power.

One or more embodiments of the present invention allows for management and distribution of computational operations at computing systems across a fleet of datacenters such that the performance of the computational operations take advantages of increased efficiency and decreased costs.

It will also be recognized by the skilled worker that, in addition to improved efficiencies in controlling power delivery from intermittent generation sources, such as wind farms and solar panel arrays, to regulated power grids, the invention provides more economically efficient control and stability of such power grids in the implementation of the technical features as set forth herein.

While the present invention has been described with respect to the above-noted embodiments, those skilled in the art, having the benefit of this disclosure, will recognize that other embodiments may be devised that are within the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the appended claims.

What is claimed is:

1. A system comprising:

a set of computing systems, wherein the set of computing systems is configured to perform computational operations using power from a power grid;

a control system configured to:

monitor a set of conditions;

receive power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

2. The system of claim 1, wherein the control system is configured to monitor the set of conditions comprising:

a price of power from the power grid; and

a plurality of parameters associated with one or more computational operations to be performed at the set of computing systems.

3. The system of claim 2, wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at least the portion option data, the price of power from the power grid, and the plurality of parameters associated with the one or more computational operations.

4. The system of claim 3, wherein the performance strategy further comprises:

an order for the set of computing systems to follow when performing the one or more computational operations, wherein the order is based on respective priorities associated with the one or more computational operations.

5. The system of claim 4, wherein the performance strategy further comprises:

at least one power consumption target that is greater than a minimum power threshold when the price of power from the power grid is below a threshold price during the time interval associated with the minimum power threshold.

6. The system of claim 1, wherein the control system is further configured to:

receive subsequent power option data based, at least in part, on the power option agreement,

wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

7. The system of claim 6, wherein the control system is further configured to:

responsive to receiving the subsequent power option data, modify the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions,

wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems.

8. The system of claim 7, wherein the control system is further configured to:

provide instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

9. The system of claim 1, wherein the control system is a remote master control system positioned remotely from the set of computing systems.

10. The system of claim 1, wherein the control system is a mobile computing device.

11. The system of claim 1, wherein the control system is configured to receive the power option data while monitoring the set of conditions.

12. The system of claim 1, wherein the control system is further configured to:

provide a request to a qualified scheduling entity (QSE) to determine the power option agreement; and

receive power option data in response to providing the request to the QSE.

13. The system of claim 1, wherein the power option data specify: (i) a first minimum power threshold associated with a first time interval in the set of time intervals, and (ii) a second minimum power threshold associated with a second time interval in the set of time intervals,

wherein the second time interval is subsequent to the first time interval.

14. The system of claim 13, wherein the control system is configured to:

determine the performance strategy for the set of computing systems such that the performance strategy comprises:

a first power consumption target for the set of computing systems for the first time interval, wherein the first power consumption target is equal to or greater than the first minimum power threshold; and

a second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

15. The system of claim 1, wherein a total duration of the set of time intervals corresponds to a twenty-four hour period.

16. The system of claim 1, wherein the set of conditions monitored by the control system further comprise:

a price of power from the power grid; and

a global mining hash rate and a price for a cryptocurrency; and

wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at the portion of the power option data, the price of power from the power grid, the global mining hash rate and the price for the cryptocurrency,

wherein the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

17. A method comprising:

monitoring, by a computing system, a set of conditions;

receiving, at the computing system, power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

18. The method of claim 17, wherein determining the performance strategy for the set of computing systems comprises:

identifying information about the set of computing systems; and

determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems.

19. The method of claim 17, further comprising:

receiving subsequent power option data based, at least in part, on the power option agreement, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds;

responsive to receiving the subsequent power option data, modifying the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions, wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems; and

providing instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

20. A non-transitory computer readable medium having stored therein instructions executable by one or more processors to cause a computing system to perform functions comprising:

monitoring a set of conditions;

receiving power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

* * * * *

EXHIBIT B

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Methods and Systems for Adjusting Power Consumption based on a Fixed-Duration Power Option Agreement

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☒ The attached application, or
- ☐ United States application or PCT international application number ______________________

  filed on ______________________________.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Michael T. McNamara Date (Optional) : Dec 2, 2019

Signature: ______________________

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Methods and Systems for Adjusting Power Consumption based on a Fixed-Duration Power Option Agreement

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number ____________ filed on ____________.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Raymond E. Cline Jr. Date (Optional) : 12/3/2019

Signature: [signature]

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

JS 44 (Rev. 06/17)

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. *(SEE INSTRUCTIONS ON NEXT PAGE OF THIS FORM.)*

I. (a) PLAINTIFFS

BEARBOX LLC and AUSTIN STORMS

(b) County of Residence of First Listed Plaintiff ____________
(EXCEPT IN U.S. PLAINTIFF CASES)

(c) Attorneys *(Firm Name, Address, and Telephone Number)*
Andrew C. Mayo, Esquire
Ashby & Geddes, 500 Delaware Ave., 8th Floor, P.O. Box 1150
Wilmington, DE 19801 (302) 654-1888

DEFENDANTS

LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR.

County of Residence of First Listed Defendant ____________
(IN U.S. PLAINTIFF CASES ONLY)

NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE TRACT OF LAND INVOLVED.

Attorneys *(If Known)*

II. BASIS OF JURISDICTION *(Place an "X" in One Box Only)*

- ❒ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question *(U.S. Government Not a Party)*
- ❒ 2 U.S. Government Defendant
- ❒ 4 Diversity *(Indicate Citizenship of Parties in Item III)*

III. CITIZENSHIP OF PRINCIPAL PARTIES *(Place an "X" in One Box for Plaintiff and One Box for Defendant)*

(For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	❒ 1	❒ 1	Incorporated *or* Principal Place of Business In This State	❒ 4	❒ 4
Citizen of Another State	❒ 2	❒ 2	Incorporated *and* Principal Place of Business In Another State	❒ 5	❒ 5
Citizen or Subject of a Foreign Country	❒ 3	❒ 3	Foreign Nation	❒ 6	❒ 6

IV. NATURE OF SUIT *(Place an "X" in One Box Only)*

Click here for: Nature of Suit Code Descriptions.

CONTRACT
- ❒ 110 Insurance
- ❒ 120 Marine
- ❒ 130 Miller Act
- ❒ 140 Negotiable Instrument
- ❒ 150 Recovery of Overpayment & Enforcement of Judgment
- ❒ 151 Medicare Act
- ❒ 152 Recovery of Defaulted Student Loans (Excludes Veterans)
- ❒ 153 Recovery of Overpayment of Veteran's Benefits
- ❒ 160 Stockholders' Suits
- ❒ 190 Other Contract
- ❒ 195 Contract Product Liability
- ❒ 196 Franchise

REAL PROPERTY
- ❒ 210 Land Condemnation
- ❒ 220 Foreclosure
- ❒ 230 Rent Lease & Ejectment
- ❒ 240 Torts to Land
- ❒ 245 Tort Product Liability
- ❒ 290 All Other Real Property

TORTS

PERSONAL INJURY
- ❒ 310 Airplane
- ❒ 315 Airplane Product Liability
- ❒ 320 Assault, Libel & Slander
- ❒ 330 Federal Employers' Liability
- ❒ 340 Marine
- ❒ 345 Marine Product Liability
- ❒ 350 Motor Vehicle
- ❒ 355 Motor Vehicle Product Liability
- ❒ 360 Other Personal Injury
- ❒ 362 Personal Injury - Medical Malpractice

PERSONAL INJURY
- ❒ 365 Personal Injury - Product Liability
- ❒ 367 Health Care/ Pharmaceutical Personal Injury Product Liability
- ❒ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
- ❒ 370 Other Fraud
- ❒ 371 Truth in Lending
- ❒ 380 Other Personal Property Damage
- ❒ 385 Property Damage Product Liability

CIVIL RIGHTS
- ❒ 440 Other Civil Rights
- ❒ 441 Voting
- ❒ 442 Employment
- ❒ 443 Housing/ Accommodations
- ❒ 445 Amer. w/Disabilities - Employment
- ❒ 446 Amer. w/Disabilities - Other
- ❒ 448 Education

PRISONER PETITIONS

Habeas Corpus:
- ❒ 463 Alien Detainee
- ❒ 510 Motions to Vacate Sentence
- ❒ 530 General
- ❒ 535 Death Penalty

Other:
- ❒ 540 Mandamus & Other
- ❒ 550 Civil Rights
- ❒ 555 Prison Condition
- ❒ 560 Civil Detainee - Conditions of Confinement

FORFEITURE/PENALTY
- ❒ 625 Drug Related Seizure of Property 21 USC 881
- ❒ 690 Other

LABOR
- ❒ 710 Fair Labor Standards Act
- ❒ 720 Labor/Management Relations
- ❒ 740 Railway Labor Act
- ❒ 751 Family and Medical Leave Act
- ❒ 790 Other Labor Litigation
- ❒ 791 Employee Retirement Income Security Act

IMMIGRATION
- ❒ 462 Naturalization Application
- ❒ 465 Other Immigration Actions

BANKRUPTCY
- ❒ 422 Appeal 28 USC 158
- ❒ 423 Withdrawal 28 USC 157

PROPERTY RIGHTS
- ❒ 820 Copyrights
- ☒ 830 Patent
- ❒ 835 Patent - Abbreviated New Drug Application
- ❒ 840 Trademark

SOCIAL SECURITY
- ❒ 861 HIA (1395ff)
- ❒ 862 Black Lung (923)
- ❒ 863 DIWC/DIWW (405(g))
- ❒ 864 SSID Title XVI
- ❒ 865 RSI (405(g))

FEDERAL TAX SUITS
- ❒ 870 Taxes (U.S. Plaintiff or Defendant)
- ❒ 871 IRS—Third Party 26 USC 7609

OTHER STATUTES
- ❒ 375 False Claims Act
- ❒ 376 Qui Tam (31 USC 3729(a))
- ❒ 400 State Reapportionment
- ❒ 410 Antitrust
- ❒ 430 Banks and Banking
- ❒ 450 Commerce
- ❒ 460 Deportation
- ❒ 470 Racketeer Influenced and Corrupt Organizations
- ❒ 480 Consumer Credit
- ❒ 490 Cable/Sat TV
- ❒ 850 Securities/Commodities/ Exchange
- ❒ 890 Other Statutory Actions
- ❒ 891 Agricultural Acts
- ❒ 893 Environmental Matters
- ❒ 895 Freedom of Information Act
- ❒ 896 Arbitration
- ❒ 899 Administrative Procedure Act/Review or Appeal of Agency Decision
- ❒ 950 Constitutionality of State Statutes

V. ORIGIN *(Place an "X" in One Box Only)*

- ☒ 1 Original Proceeding
- ❒ 2 Removed from State Court
- ❒ 3 Remanded from Appellate Court
- ❒ 4 Reinstated or Reopened
- ❒ 5 Transferred from Another District *(specify)*
- ❒ 6 Multidistrict Litigation - Transfer
- ❒ 8 Multidistrict Litigation - Direct File

VI. CAUSE OF ACTION

Cite the U.S. Civil Statute under which you are filing **(*Do not cite jurisdictional statutes unless diversity*)**:
35 U.S.C. § 256 / 18 U.S.C. § 1836

Brief description of cause:
Correction of patent inventorship / trade secrets action

VII. REQUESTED IN COMPLAINT:

❒ CHECK IF THIS IS A **CLASS ACTION** UNDER RULE 23, F.R.Cv.P.

DEMAND $

CHECK YES only if demanded in complaint:
JURY DEMAND: ☒ Yes ❒ No

VIII. RELATED CASE(S) IF ANY

(See instructions): JUDGE ____________ DOCKET NUMBER ____________

DATE
04/14/2021

SIGNATURE OF ATTORNEY OF RECORD
/s/ Andrew C. Mayo

FOR OFFICE USE ONLY

RECEIPT # ________ AMOUNT ________ APPLYING IFP ________ JUDGE ________ MAG. JUDGE ________

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR. Defendants.	)	C.A. No. 21-534-MN **JURY TRIAL DEMANDED**

AMENDED COMPLAINT

Plaintiffs BearBox LLC ("BearBox") and Austin Storms (collectively, "Plaintiffs") bring this action against Lancium LLC ("Lancium"), Michael T. McNamara, and Raymond E. Cline, Jr. (collectively "Defendants") to correct the inventorship of U.S. Patent No. 10,608,433 (the "'433 Patent") and to recover damages, injunctive relief, declaratory relief, and other remedies for Defendants' wrongful actions to obtain, misuse, disclose, and claim as their own Plaintiffs' proprietary cryptocurrency mining technology. Plaintiffs further allege as follows:

INTRODUCTION

1. This case is about the Defendants' theft of inventions that rightfully belong to Plaintiffs.

2. Plaintiffs developed proprietary technology relating to cryptocurrency mining systems (the "BearBox Technology"). By way of background, the BearBox Technology generally relates to an energy-efficient cryptocurrency mining system and related methods that reduce the inefficiency and environmental impact of energy-expensive mining operations by better utilizing available energy resources to increase stability of the energy grid, minimize a

Case: 23-1922 Document: 26-1 Page: 279 Filed: 11/20/2023

mining operation's impact on peak-demand, and also alleviate energy over-supply conditions. The BearBox Technology can be used to mine cryptocurrency, such as Bitcoin.

3. The Defendants induced the Plaintiffs to disclose the BearBox Technology to them under the guise of a possible business deal between Defendants and Plaintiffs to jointly commercialize the BearBox Technology. Before disclosing the BearBox Technology to Defendants, Plaintiffs obtained assurances of confidentiality from Defendants.

4. The Defendants stole the BearBox Technology from Plaintiffs by converting and misappropriating it and claiming it as their own. Defendants filed a U.S. patent application that wrongfully disclosed the BearBox Technology to the U.S. Patent and Trademark Office and ultimately to the public. The claimed subject matter of the '433 Patent falls fully within the scope of the BearBox Technology. And by obtaining the '433 Patent with claims directed to the BearBox Technology, the Defendants have wrongfully obtained a patent covering the BearBox Technology and wrongfully claimed the BearBox Technology as their own.

5. Plaintiffs bring this action to correct the named inventors on the '433 Patent. The inventions claimed in the '433 Patent are inventions conceived by Storms, founder and president of BearBox.

PARTIES

6. Plaintiff BearBox LLC ("BearBox") is a limited liability company organized and existing under the laws of Louisiana with its principal place of business at 4422 Highway 22, Mandeville, Louisiana 70471.

7. Plaintiff Austin Storms is an individual residing in Mandeville, Louisiana.

8. On information and belief, Defendant Lancium is a Delaware limited liability company with its principal place of business at 6006 Thomas Rd, Houston, Texas 77041. On

information and belief, Lancium has a registered agent capable of accepting service in this district, Harvard Business Services, Inc. with a place of business at 16192 Coastal Highway, Lewes, DE 19958.

9. On information and belief, Defendant Michael T. McNamara is the Chief Executive Officer and a founder of Lancium and resides in Newport Beach, California. Defendant McNamara is named as a purported inventor on the face of the ’433 Patent.

10. On information and belief, Defendant Raymond E. Cline, Jr. is the Chief Computing Officer of Lancium and resides in Houston, Texas. Defendant Cline is named as a purported inventor on the face of the ’433 Patent.

JURISDICTION

11. This is an action seeking correction of the named inventors of a United States patent under 35 U.S.C. § 256. As such, this action arises under the laws of the United States.

12. This Court has exclusive subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a) because the matter arises under an Act of Congress relating to patents, specifically 35 U.S.C. § 256.

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13. The Court has supplemental jurisdiction under 28 U.S.C. § 1367 over all asserted claims under state law because those claims are so related to the claims in this action that arise under federal law that they form part of the same case or controversy.

14. The Court also has jurisdiction pursuant to 28 U.S.C. § 1332, as complete diversity of citizenship exists among the parties, and the amount in controversy exceeds $75,000. Plaintiff BearBox is a citizen of the State of Louisiana because it is organized under the laws of the State of Louisiana and has its principal place of business in the State of Louisiana. Plaintiff

Storms is a citizen of the State of Louisiana because he resides in the State of Louisiana. In contrast, none of the Defendants are citizens of the State of Louisiana. Defendant Lancium is a citizen of the States of Delaware and Texas because it is organized under the laws of the State of Delaware and has its principal place of business in the State of Texas. Defendant McNamara is a citizen of the State of California because he resides in the State of California. Defendant Cline is a citizen of the State of Texas because he resides in the State of Texas. Therefore, because the Plaintiffs are both citizens of the State of Louisiana (and no other states) for purposes of diversity jurisdiction, and none of the Defendants are citizens of the State of Louisiana, complete diversity exists among the parties.

15. This Court has general personal jurisdiction over Lancium because it is organized under the laws of the State of Delaware and because it maintains an ongoing presence in this District at least through its registered agent.

16. This Court has specific personal jurisdiction over each of Defendants McNamara and Cline at least under Title 6 of the Delaware Code, § 18-109(a).

17. On information and belief, Defendant McNamara is the Chief Executive Officer of Lancium. On information and belief, as the Chief Executive Offer, McNamara participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

18. McNamara is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from the interests of Lancium and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claims against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant

McNamara together. Plaintiffs' claims against Defendant McNamara arise out of his exercise of his powers as Chief Executive Officer of Lancium.

19. On information and belief, Defendant Cline is the Chief Computing Officer of Lancium. On information and belief, as the Chief Computing Officer, Cline participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

20. Cline is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from Lancium's interest and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claim against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant Cline together. Plaintiffs' claims against Defendant Cline arise out of his exercise of his powers as Chief Computing Officer of Lancium.

21. The actions of Defendants McNamara and Cline establish sufficient minimum contacts with Delaware under Delaware law and the United States Constitution to give this Court personal jurisdiction over each of them.

22. As described below, each Defendant has committed acts giving rise to this action.

VENUE

23. Venue is proper in this District under 28 U.S.C. § 1391(b)(3) because there is no district in which an action may otherwise be brought as provided in § 1391(b) and Defendant Lancium is subject to the Court's personal jurisdiction with respect to this action.

PLAINTIFFS' PROPRIETARY CRYPTOCURRENCY MINING TECHNOLOGY

24. As of 2018, the amount of energy required to process computer algorithms to mine cryptocurrencies like Bitcoin was three times greater than the energy required to physically mine gold. Conventional mining of "copper, gold, platinum, and rare earth oxides are 4, 5, 7, and 9 megajoules to generate one U.S. dollars," while "it costs an average of 17 megajoules to mine $1 worth of bitcoin."[1] The large amount of energy required to mine cryptocurrencies can make such mining financially prohibitive, and even when financially lucrative, the large energy requirements make cryptocurrency mining harmful to the global environment, with studies showing carbon dioxide emissions from cryptocurrency mining "single-handedly rais[ing] global temperatures by 2 degrees by 2023." *Id*.

25. At the same time, some forms of electrical power generation are terribly inefficient. When producers of electrical power are unable to quickly adjust their operations in response to dynamically changing grid conditions, these producers frequently sell power at low or even negative prices until demand and market prices increase.

26. Because cryptocurrency mining is a computationally demanding process, it requires significant energy. As a result, industrial-scale cryptocurrency mining places a large energy burden on the power grid, driving demand and costs as well as increasing the likelihood of grid component failure.

27. In late 2018 and early 2019, Austin Storms sought to address these problems by developing energy-efficient cryptocurrency mining systems and methods that reduce the environmental impact of energy-intensive mining operations. Storms conceived of a system that

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[1] https://www.marketwatch.com/story/mining-bitcoin-is-3-times-more-expensive-than-mining-gold-research-paper-finds-2018-11-06

better uses available energy resources to increase the stability of the energy grid, minimize a mining operation's impact on peak-demand, and alleviate energy over supply conditions, all while decreasing the overall energy costs of the mining operation and increasing its profitability.

28. Austin Storms conceived of and developed the BearBox Technology. Storms is the president and founder of BearBox. The BearBox Technology includes hardware and software components. Structurally, the BearBox Technology includes a housing for a plurality of miners (such as ASICs, graphics cards, or the like) under the direction of a smart controller(s).

29. The smart controller monitors various external factors, such as current and expected energy demand and pricing information, current and expected cryptocurrency pricing, and the like. Based on these external factors, the system may determine whether conditions are appropriate to mine cryptocurrency and, if so, subsequently mines the cryptocurrency. Optionally, the system also includes other components for cooling, air-filtration, and related features.

30. In the BearBox Technology, a controller (such as a power distribution unit, network interface, or the like) monitors various external factors, such as current and expected energy demand/pricing information, current and expected cryptocurrency pricing, and the like. Based on these external factors, the controller(s) determines appropriate times to mine cryptocurrency in accordance with a desired performance strategy (for example, profitability thresholds). At the appropriate times, the controller initiates mining, for example, by powering on the miners.

DEFENDANTS WRONGFULLY CLAIM THE BEARBOX TECHNOLOGY AS THEIR OWN

31. In May 2019, Storms attended the Fidelity FCAT Mining Summit in Boston, Massachusetts on behalf of BearBox to promote the BearBox Technology and seek potential customers for his revolutionary system.

32. While at the conference, Storms met Defendant McNamara. Defendant McNamara showed immediate interest in the BearBox Technology. Under the rouse of a potential business relationship, McNamara pumped Storms for details about the BearBox Technology over the course of several exchanges, which included conversations, emails, and text messages about the BearBox Technology. Storms took McNamara to dinner where McNamara continued to pump Storms for details about the BearBox Technology. At all times before and during Storms's disclosure of this information, Storms told McNamara that the BearBox Technology was confidential, and Storms relied on McNamara's good faith assurances that he would keep confidential the information he received from Storms about the BearBox Technology.

33. Following the conference, McNamara continued to press Storms for additional details about the BearBox Technology via text messaging and email. Again relying on Defendant McNamara's assurances of confidentiality, Storms provided annotated system diagrams, component specifications, and modeled data sets to mimic real-world Bitcoin and energy prices. Storms included express confidentiality notices in his communications with Defendant McNamara.

34. After Storms disclosed the BearBox Technology to McNamara, McNamara abruptly ended all communications with Storms.

35. Storms last communicated with McNamara on May 9, 2019 via e-mail, and after sending that message, Storms did not hear from McNamara again.

36. At that time, Storms understood that McNamara was not interested in investing in the BearBox Technology. He had no reason to suspect that McNamara would steal the BearBox Technology and claim it as his own.

37. On information and belief, Defendants filed U.S. provisional patent application No. 62/927,119 on October 28, 2019, naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

38. In addition to falsely claiming to be the inventors of the inventions disclosed in the application, Defendants wrongfully disclosed, without authorization, the confidential BearBox Technology to the United States Patent and Trademark Office.

39. Likewise, on December 4, 2019, Defendants filed U.S. Patent Application Serial No. 16/702,931, once again naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

40. The ’433 Patent issued on March 31, 2020 naming Defendants McNamara and Cline as the sole purported inventors on the face of the patent. A true and correct copy of the ’433 Patent is attached hereto as Exhibit A.

41. The inventions claimed in the ’433 patent fall within the scope of the BearBox Technology, yet Defendants falsely identified themselves as the inventors of the claimed inventions, when, in fact, Storms is the sole inventor of the claimed inventions.

42. On information and belief, McNamara and Cline assigned their purported rights in the ’433 patent to Lancium. On information and belief, at all times, Lancium was aware that

McNamara and Cline, both officers of Lancium, were not the rightful inventors of the BearBox Technology disclosed in the patent and the inventions claimed in the patent.

43. Defendants McNamara and Cline each submitted signed declarations falsely swearing that they were "an original joint inventor" of the claimed subject matter . A true and correct copy of Defendant McNamara's and Defendant Cline's declarations are attached as Exhibit B.

44. On August 14, 2020, Lancium filed a lawsuit in the U.S. District Court for the Western District of Texas against Layer1 Technologies, Inc. ("Layer1") asserting that Layer1 infringes the '433 patent. That case is captioned *Lancium LLC v. Layer1 Technologies, Inc.*, Case No. 6:20-cv-739 (W.D. Texas) (the "Layer1 Lawsuit").

45. As part of the Layer1 Lawsuit, Defendants falsely asserted that McNamara and Cline are the sole inventors of the inventions claimed in the '433 patent.

46. Plaintiffs became aware of Defendants' wrongful use of the BearBox Technology on or about August 17, 2020, when they learned about the Layer1 Lawsuit through a press release dated August 14, 2020, posted by Lancium on PRNewswire. That press release is available at the following URL: https://www.prnewswire.com/news-releases/controllable-load-resource-clr-market-leader-lancium-files-patent-infringement-lawsuit-against-layer1-301112687.html.

47. Before seeing the August 14, 2020 press release, Plaintiffs were unaware of Defendants' wrongful use of the BearBox Technology and was unaware of the '433 patent.

48. On March 5, 2021, Lancium and Layer1 entered a Stipulation to Dismiss with Prejudice in the Layer1 Lawsuit. According to the stipulation, the parties had entered a Settlement Agreement to resolve the Layer1 Lawsuit.

49. According to a press release issued by Lancium on March 8, 2021, Lancium and Layer 1 "have entered into a mutually beneficial partnership. Layer1 has licensed Lancium's intellectual property and Lancium will provide Smart Response™ software and services to Layer1." The press release is available at the following URL: https://www.prnewswire.com/news-releases/lancium-and-layer1-settle-patent-infringement-suit-301242602.html

50. On information and belief, as part of the Settlement Agreement between Lancium and Layer1 to settle the Layer1 Lawsuit, Lancium received and continues to receive valuable consideration from Layer1, all of which rightly belongs to Plaintiffs, the rightful owners of the inventions claimed in the '433 Patent.

COUNT I
CORRECTION OF INVENTORSHIP FOR THE '433 PATENT: AUSTIN STORMS AS SOLE INVENTOR

51. Plaintiffs incorporate the above paragraphs by reference.

52. Storms is the sole inventor of the subject matter claimed in the '433 Patent.

53. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the '433 patent and the currently listed inventors on the '433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms or BearBox.

54. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the '433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT II
IN THE ALTERNATIVE, CORRECTION OF INVENTORSHIP FOR THE ’433 PATENT: AUSTIN STORMS AS JOINT INVENTOR WITH THE CURRENTLY NAMED INVENTORS

55. Plaintiffs incorporates the above paragraphs by reference.

56. In the alternative, Storms is a joint inventor of the subject matter claimed in the ’433 Patent and should be added to the individuals currently named as inventors on the ’433 Patent.

57. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the ’433 patent and the currently listed inventors on the ’433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms.

58. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the ’433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT III
CONVERSION BY LANCIUM, MCNAMARA, AND CLINE

59. Plaintiffs incorporates the above paragraphs by reference.

60. Austin Storms, in his capacity as founder and President of BearBox, conceived, developed, and reduced to practice the BearBox Technology. Plaintiffs own the BearBox Technology, related know-how, and related intellectual property. Plaintiffs owned this property during all relevant time periods in this suit. Information on the BearBox Technology was provided to Defendants solely for the purposes of evaluation for a potential business relationship and under strict confidentiality obligations.

61. Defendants assumed dominion and control over the BearBox Technology by claiming it as their own in the ’433 patent. Through their wrongful conduct in obtaining the ’433 Patent and claiming the BearBox Technology as their own, the Defendants have wrongfully obtained the purported ability to exclude Plaintiffs and others from using the BearBox Technology. This constitutes unauthorized and unlawful conversion by Defendants.

62. As a result of Defendants’ wrongful actions, Plaintiffs will suffer imminent and irreparable damages in an amount to be proven at trial. In particular, Plaintiffs have been damaged by losing valuable intellectual property from which Plaintiffs would have derived substantial revenue via licensing and/or selling patented products.

COUNT IV
UNJUST ENRICHMENT BY LANCIUM, MCNAMARA, AND CLINE

63. Plaintiffs incorporate the above paragraphs by reference.

64. Plaintiffs conferred a benefit on Defendants by providing them valuable intellectual property about cryptocurrency mining systems and related confidential information and materials under the boundaries of a potential collaboration between BearBox and Lancium.

65. Defendants accepted that cryptocurrency mining intellectual property and, indeed, continuously asked Storms to provide more information and materials, having recognized the benefit that Defendants received by having access to the BearBox Technology.

66. Defendants accepted and retained the BearBox Technology, and used it to their own advantage, at Plaintiffs’ expense.

67. Defendants have been and continue to be unjustly enriched by profiting from their wrongful conduct. In particular, Defendants have unlawfully used Plaintiffs’ property by asserting inventorship over the BearBox Technology, and deriving an unjust benefit from

exploiting Storms's cryptocurrency mining inventions. It would be inequitable for Defendants to retain these benefits under these circumstances.

68. Plaintiffs have incurred, and continue to incur, detriment in the form of loss of money and property as a result of Defendants' wrongful use of Plaintiffs' intellectual property, including the right to any patent based on their own intellectual property. The intellectual property, including the right to any patents based on Plaintiffs' intellectual property and to any patent documents (including assignment documents), U.S. and foreign, are unique and there is no adequate remedy at law.

69. The harm to Plaintiffs is continuous, substantial, and irreparable.

COUNT V
NEGLIGENT MISREPRESENTATION BY LANCIUM AND MCNAMARA

70. Plaintiffs incorporate the above paragraphs by reference.

71. In connection with the potential work involving cryptocurrency mining systems and related methods, Storms told Defendant McNamara that the cryptocurrency mining systems and related methods were proprietary to Plaintiffs and not to be used or shared outside of Lancium. Defendant McNamara gave his word that he would abide by this confidentiality. On information and belief, Defendant McNamara agreed to keep the BearBox Technology confidential despite later recklessly incorporating the BearBox Technology into his own patent applications and swearing, as recently as December 4, 2019, that he is an inventor of the BearBox Technology. Storms relied on Defendant McNamara's assurances of confidentiality and continued to share details about the BearBox Technology with Defendants.

72. If Plaintiffs had known that Defendants would secretly incorporate the BearBox Technology into Defendants' own patent applications to claim them as Defendants' intellectual

property, Plaintiffs would not have continued working with and sharing intellectual property with Defendants.

73. Plaintiffs suffered a pecuniary loss based on this reliance including the loss of potential patent rights, and the costs of Plaintiffs' know-how converted under the guise of a potential business relationship.

JURY DEMAND

74. Under Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiffs respectfully demand a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, BearBox respectfully requests the following relief:

A. An order that the Director of the United States Patent and Trademark Office correct the inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

B. Alternatively, an order that Defendants sign the requisite documents to correct inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

C. A declaration that Austin Storms is the sole inventor, or, in the alternative, is a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

D. A preliminary and a permanent injunction enjoining Defendants Lancium, McNamara, and Cline from asserting that McNamara or Cline are inventors of the '433 Patent in violation of the United States federal patent laws;

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E. An order that Defendants immediately transfer to Plaintiffs all right, title, and interest in all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of Plaintiffs' intellectual property;

F. An order for a constructive trust over all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of Plaintiffs' intellectual property;

G. Financial relief including damages, consequential damages, disgorgement of Defendants' ill-gotten profits, Defendants' unjust enrichment, reasonable royalty damages, lost profits damages, reliance damages, and/or all other appropriate financial relief, all in an amount to be determined at trial, with interest;

H. An award of the amount by which Defendants have been unjustly enriched by their actions set forth in this Complaint and their purported ownership of patents covering Plaintiffs' intellectual property;

I. A finding that this is an exceptional case warranting imposition of attorney fees against Defendants and an award to Plaintiffs of its reasonable costs and attorney fees incurred in bringing this action pursuant to 35 U.S.C. § 285; and

J. An award of such further relief at law or in equity, such as preliminary and/or permanent injunctive relief, as the Court deems just and proper.

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Dated: May 24, 2021

EXHIBIT A

US010608433B1

(12) **United States Patent**
McNamara et al.

(10) **Patent No.: US 10,608,433 B1**
(45) **Date of Patent: Mar. 31, 2020**

(54) **METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT**

(71) Applicant: **Lancium LLC**, Houston, TX (US)

(72) Inventors: **Michael T. McNamara**, Newport Beach, CA (US); **Raymond E. Cline, Jr.**, Houston, TX (US)

(73) Assignee: **Lancium LLC**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/702,931**

(22) Filed: **Dec. 4, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/927,119, filed on Oct. 28, 2019.

(51) **Int. Cl.**
H02J 3/14 (2006.01)
H02J 3/00 (2006.01)
G06F 1/3203 (2019.01)

(52) **U.S. Cl.**
CPC ***H02J 3/14*** (2013.01); ***G06F 1/3203*** (2013.01); ***H02J 3/008*** (2013.01)

(58) **Field of Classification Search**
CPC H02J 3/14; H02J 3/008; G06F 1/3203
See application file for complete search history.

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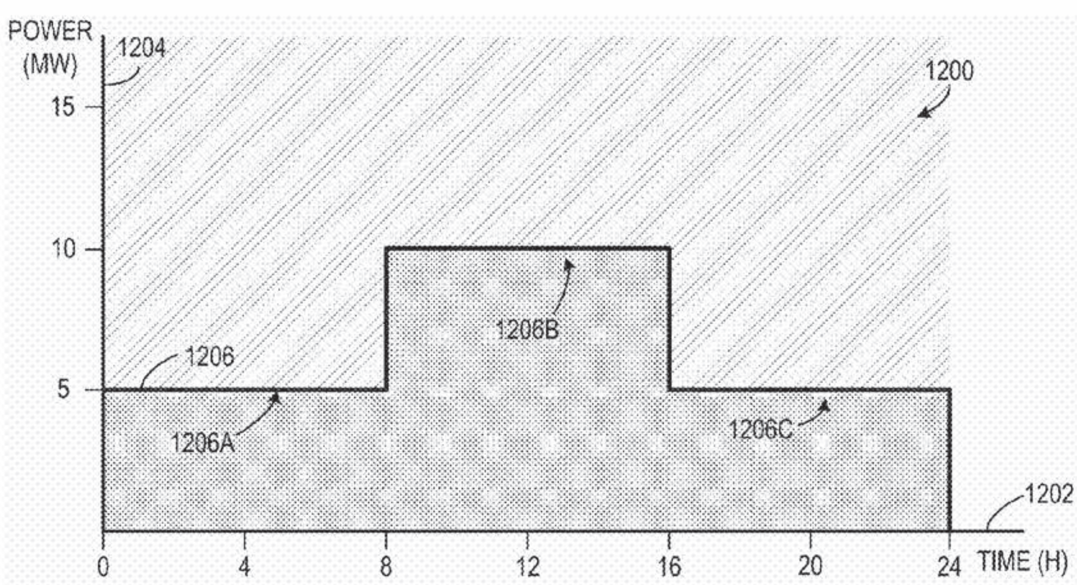
Primary Examiner — Christopher E. Everett
(74) *Attorney, Agent, or Firm* — McDonnell Boehnen Hulbert & Berghoff LLP

(57) **ABSTRACT**

Examples relate to adjusting load power consumption based on a power option agreement. A computing system may receive power option data that is based on a power option agreement and specify minimum power thresholds associated with time intervals. The computing system may determine a performance strategy for a load (e.g., set of computing systems) based on a combination of the power option data and one or more monitored conditions. The performance strategy may specify a power consumption target for the load for each time interval such that each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The computing system may provide instructions the set of computing systems to perform one or more computational operations based on the performance strategy.

20 Claims, 16 Drawing Sheets



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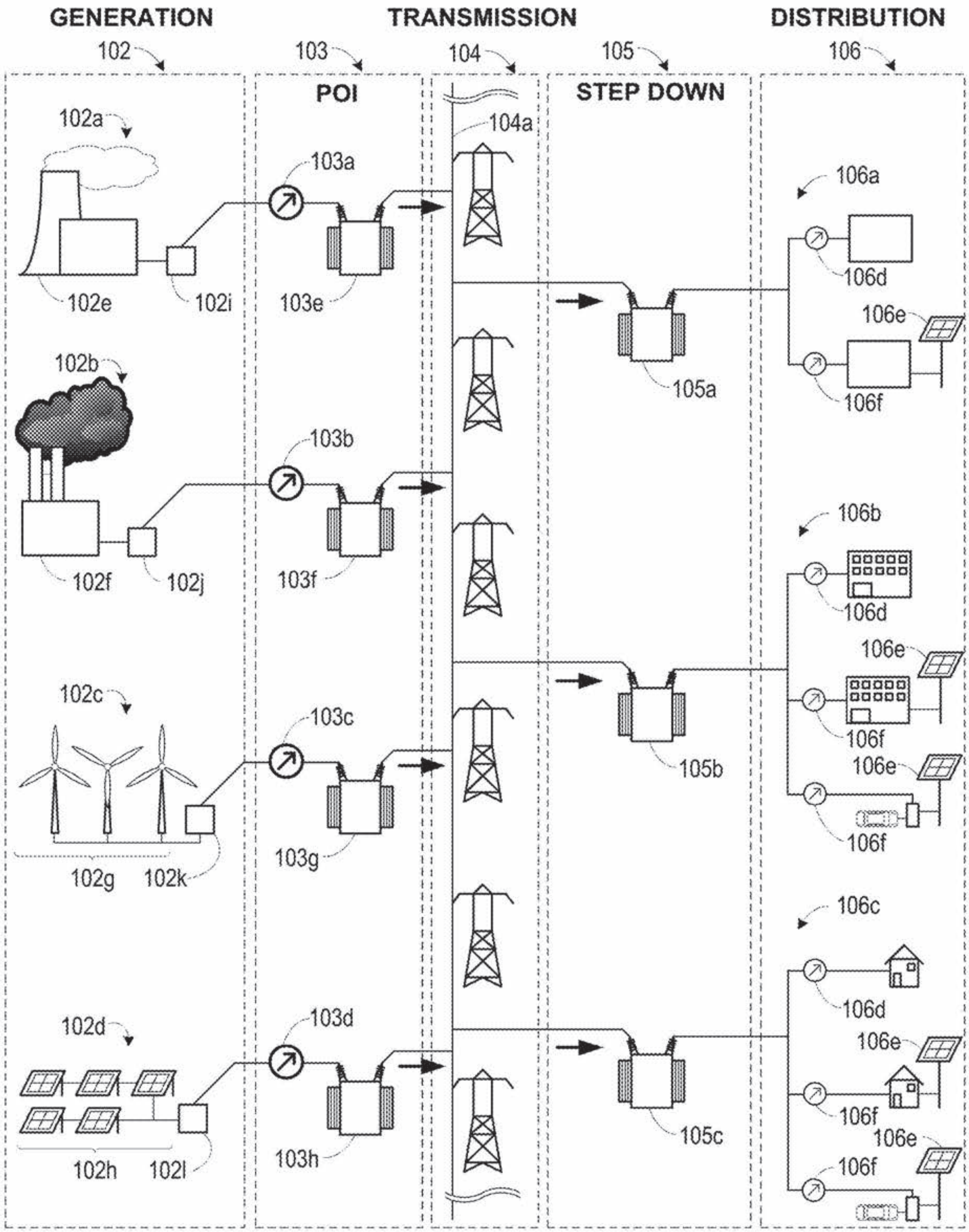

PRIOR ART
FIGURE 1

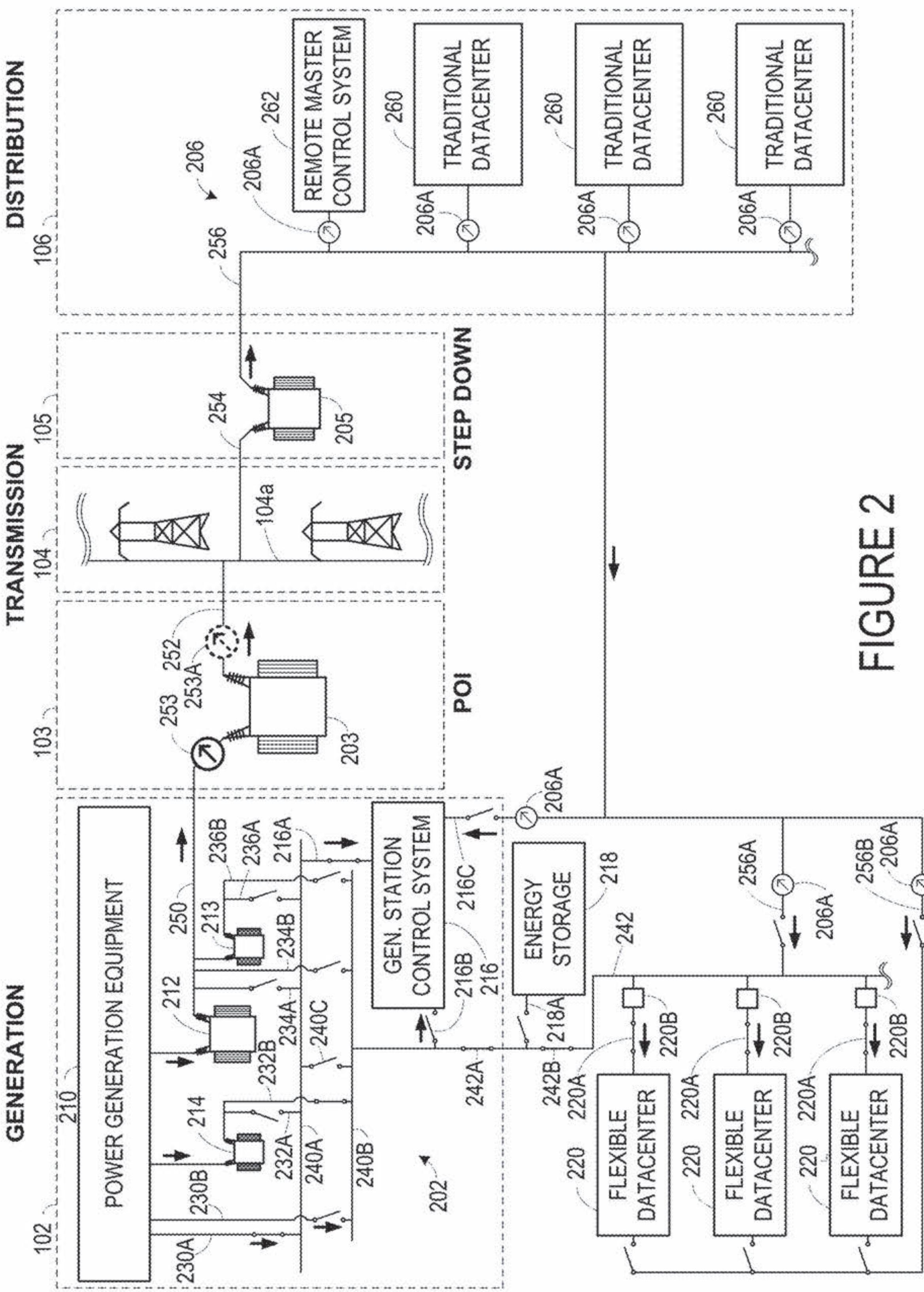
GENERATION
TRANSMISSION
DISTRIBUTION
POI
STEP DOWN
POWER GENERATION EQUIPMENT
GEN. STATION CONTROL SYSTEM
ENERGY STORAGE
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
REMOTE MASTER CONTROL SYSTEM
TRADITIONAL DATACENTER
TRADITIONAL DATACENTER
TRADITIONAL DATACENTER
102
103
104
104a
105
106
202
203
205
206
206A
210
212
213
214
216
216A
216B
216C
218
218A
220
220A
220B
230A
230B
232A
232B
234A
234B
236A
236B
240A
240B
240C
242
242A
242B
250
252
253
253A
254
256
256A
256B
260
262

FIGURE 2

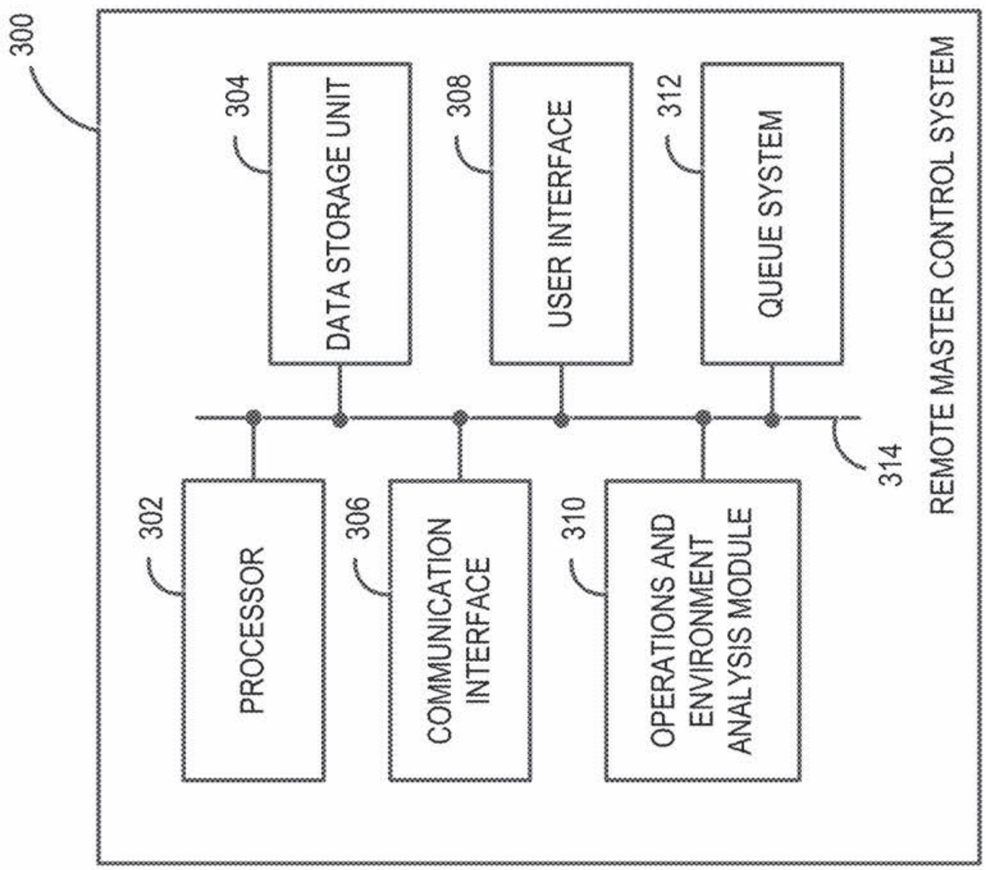
300
304
DATA STORAGE UNIT
308
USER INTERFACE
312
QUEUE SYSTEM
302
PROCESSOR
306
COMMUNICATION INTERFACE
310
OPERATIONS AND ENVIRONMENT ANALYSIS MODULE
314
REMOTE MASTER CONTROL SYSTEM

FIGURE 3

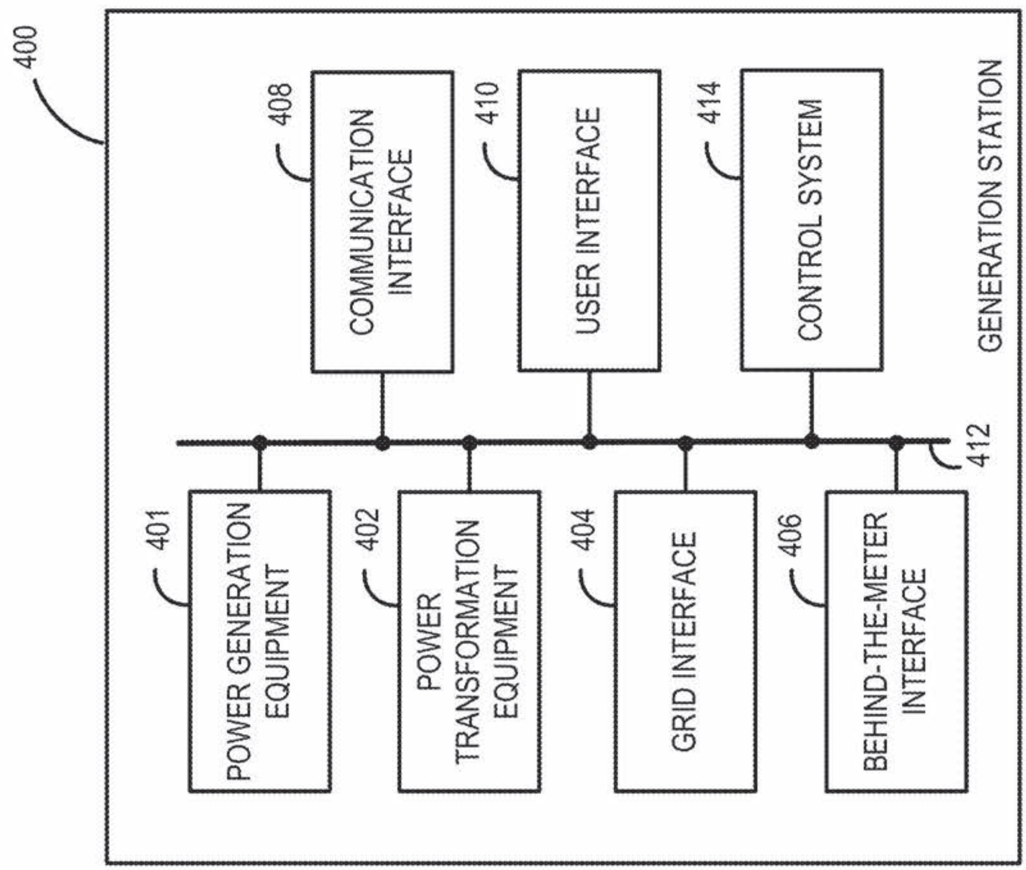
400
GENERATION STATION
408
COMMUNICATION INTERFACE
410
USER INTERFACE
414
CONTROL SYSTEM
412
401
POWER GENERATION EQUIPMENT
402
POWER TRANSFORMATION EQUIPMENT
404
GRID INTERFACE
406
BEHIND-THE-METER INTERFACE

FIGURE 4

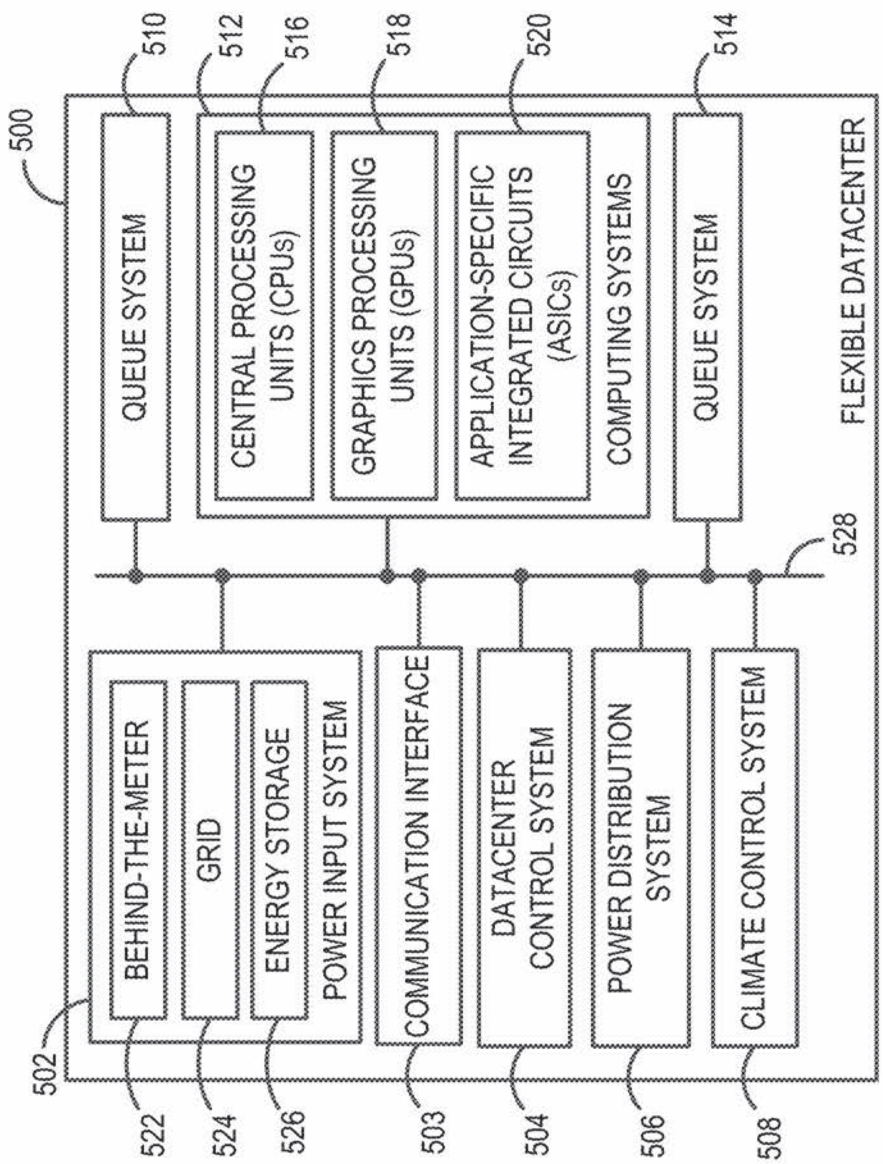
500
QUEUE SYSTEM
510
512
516
CENTRAL PROCESSING UNITS (CPUs)
518
GRAPHICS PROCESSING UNITS (GPUs)
520
APPLICATION-SPECIFIC INTEGRATED CIRCUITS (ASICs)
COMPUTING SYSTEMS
514
QUEUE SYSTEM
FLEXIBLE DATACENTER
528
502
BEHIND-THE-METER
522
GRID
524
ENERGY STORAGE
526
POWER INPUT SYSTEM
COMMUNICATION INTERFACE
503
DATACENTER CONTROL SYSTEM
504
POWER DISTRIBUTION SYSTEM
506
CLIMATE CONTROL SYSTEM
508

FIGURE 5

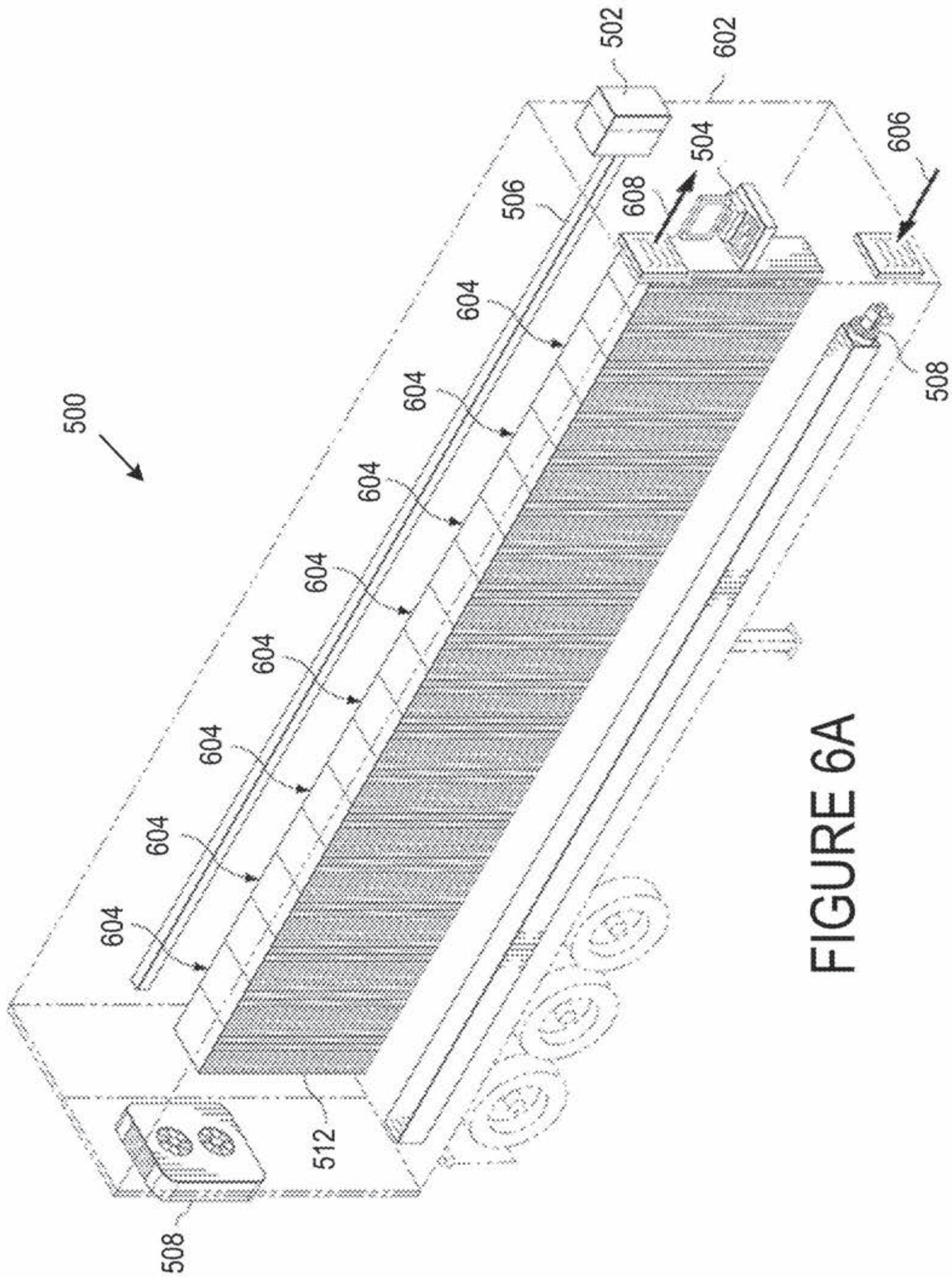
500
502
602
506
504
608
606
604
604
604
604
604
604
604
604
508
512
508

FIGURE 6A

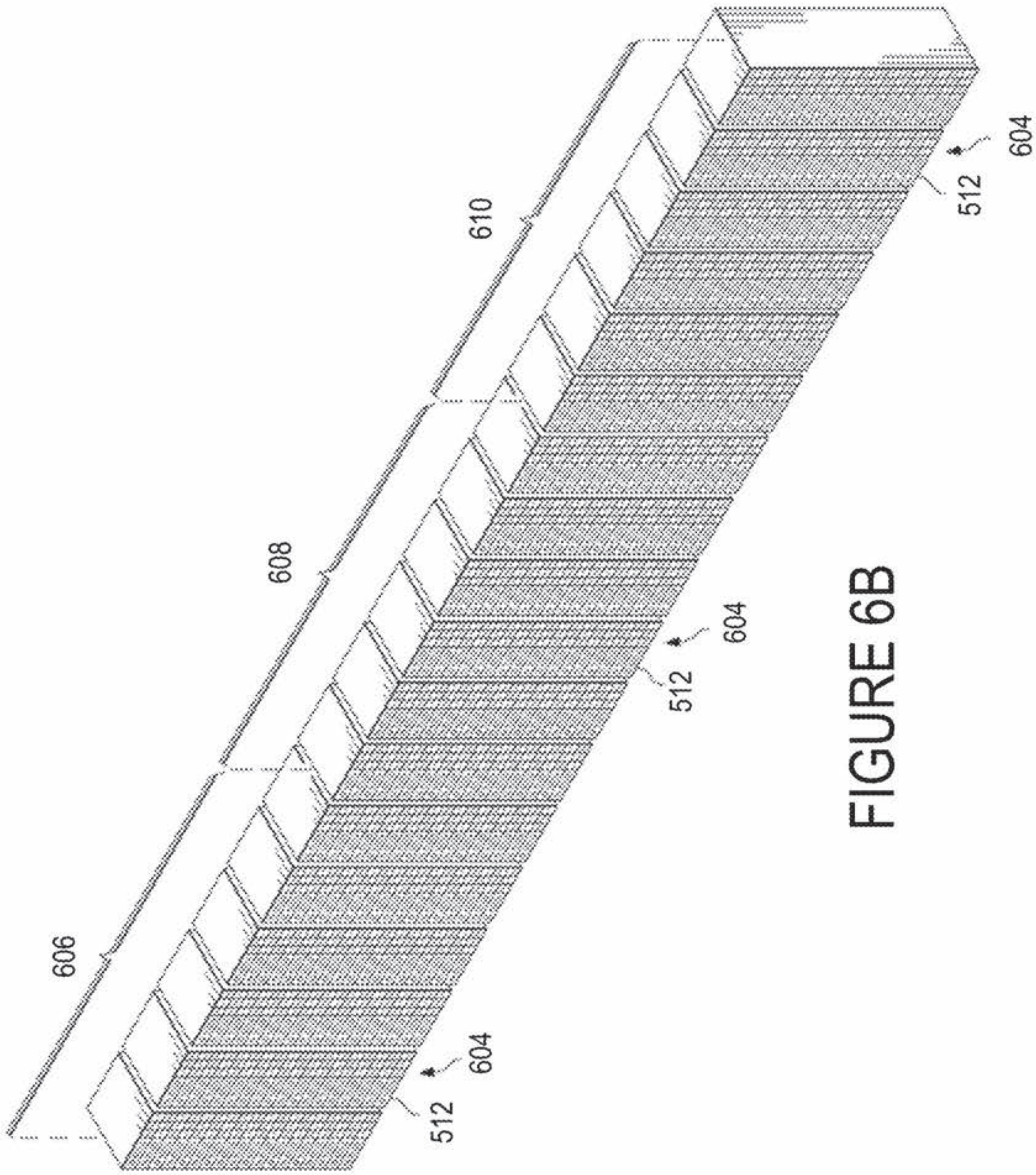

FIGURE 6B

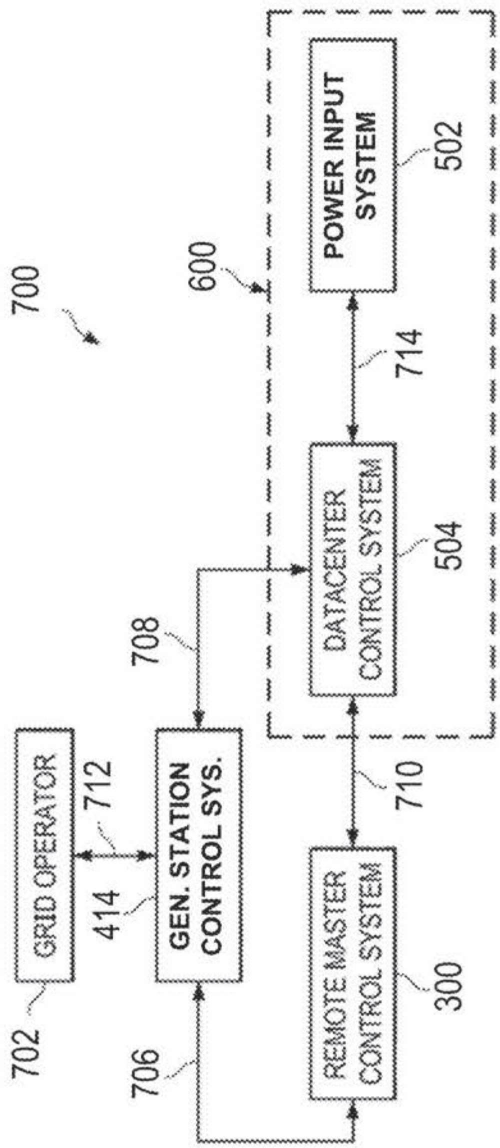
700
600
POWER INPUT SYSTEM
502
714
DATACENTER CONTROL SYSTEM
504
708
GRID OPERATOR
702
712
414
GEN. STATION CONTROL SYS.
710
REMOTE MASTER CONTROL SYSTEM
300
706

FIGURE 7

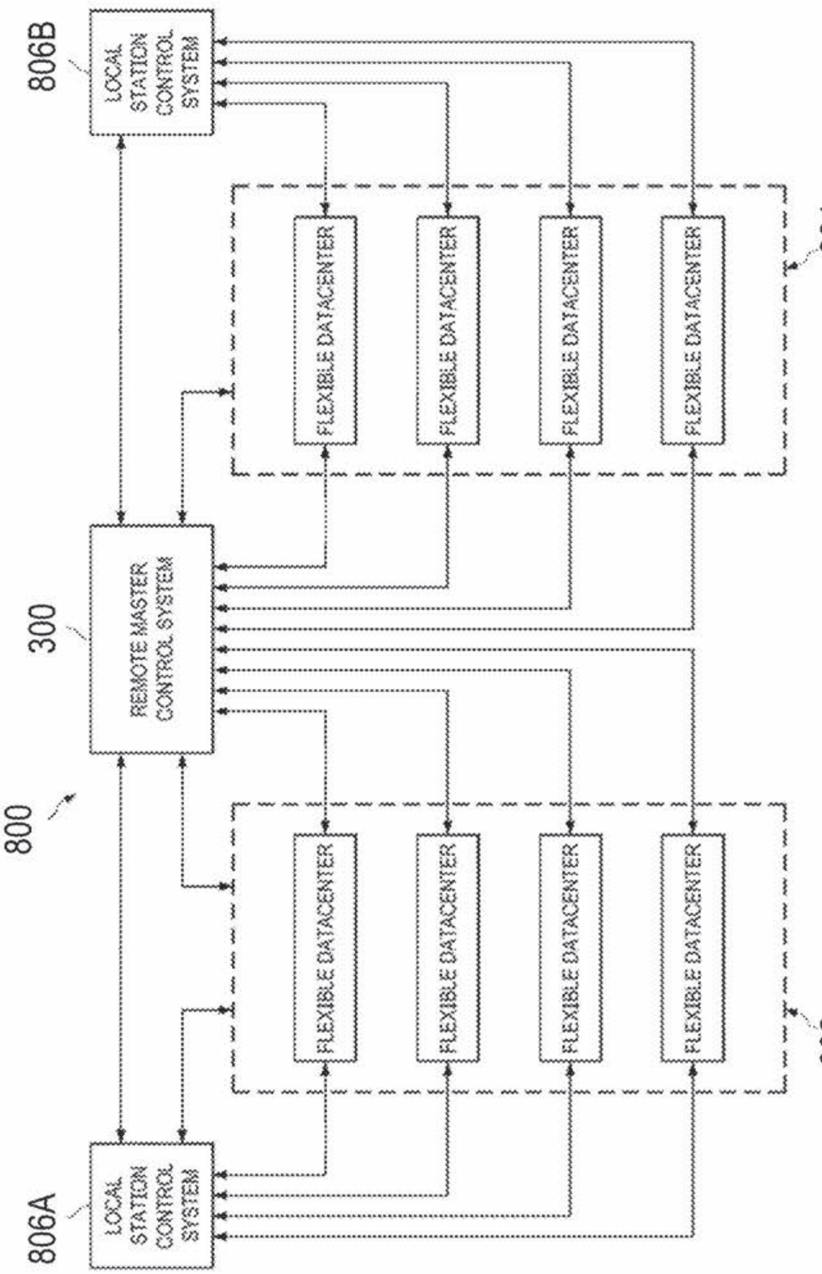
806B
LOCAL STATION CONTROL SYSTEM
804
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
300
REMOTE MASTER CONTROL SYSTEM
800
802
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
FLEXIBLE DATACENTER
806A
LOCAL STATION CONTROL SYSTEM

FIGURE 8

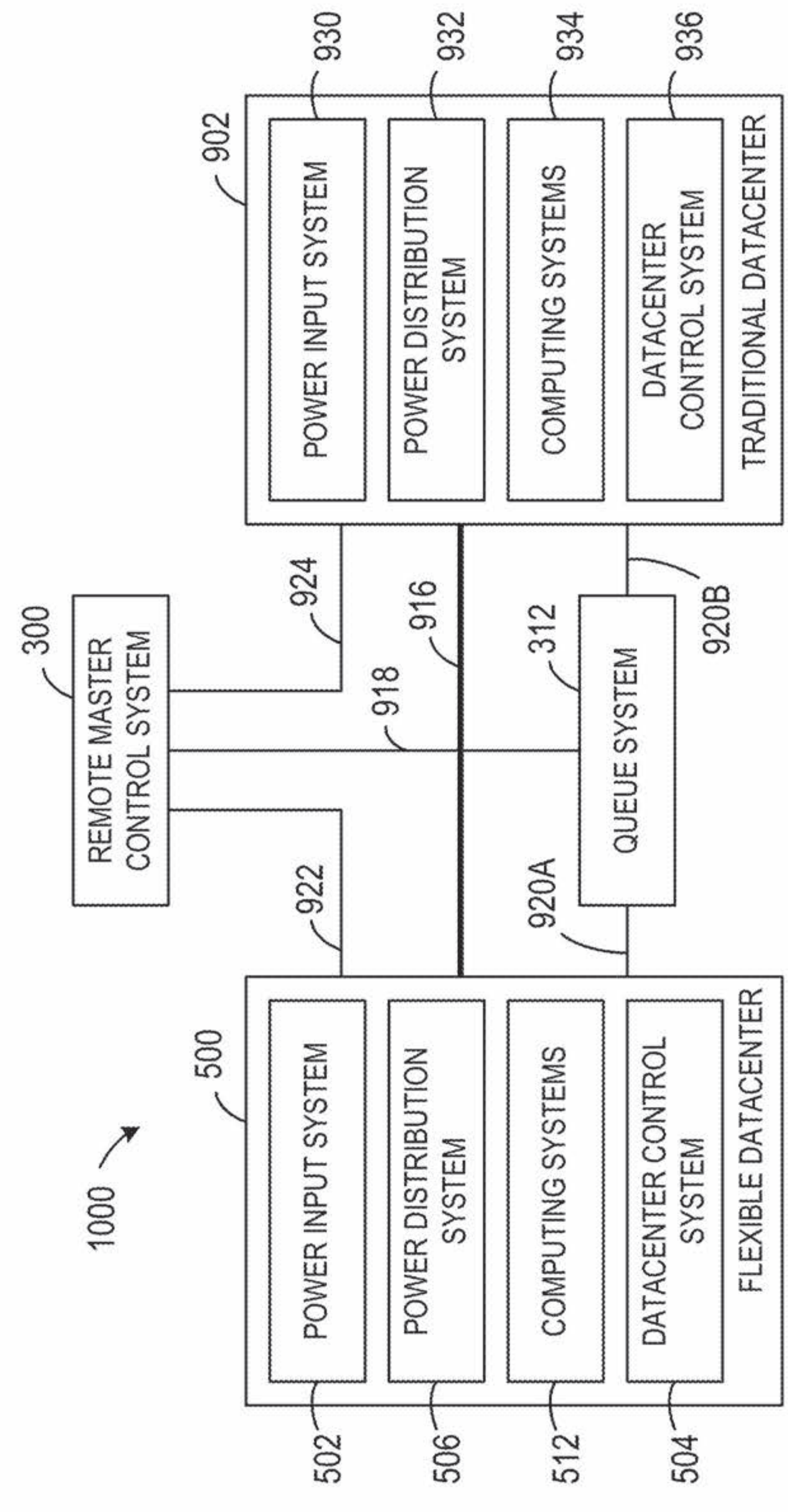
1000
500
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
FLEXIBLE DATACENTER
502
506
512
504
300
REMOTE MASTER CONTROL SYSTEM
922
924
916
918
312
QUEUE SYSTEM
920A
920B
902
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
TRADITIONAL DATACENTER
930
932
934
936

FIGURE 9

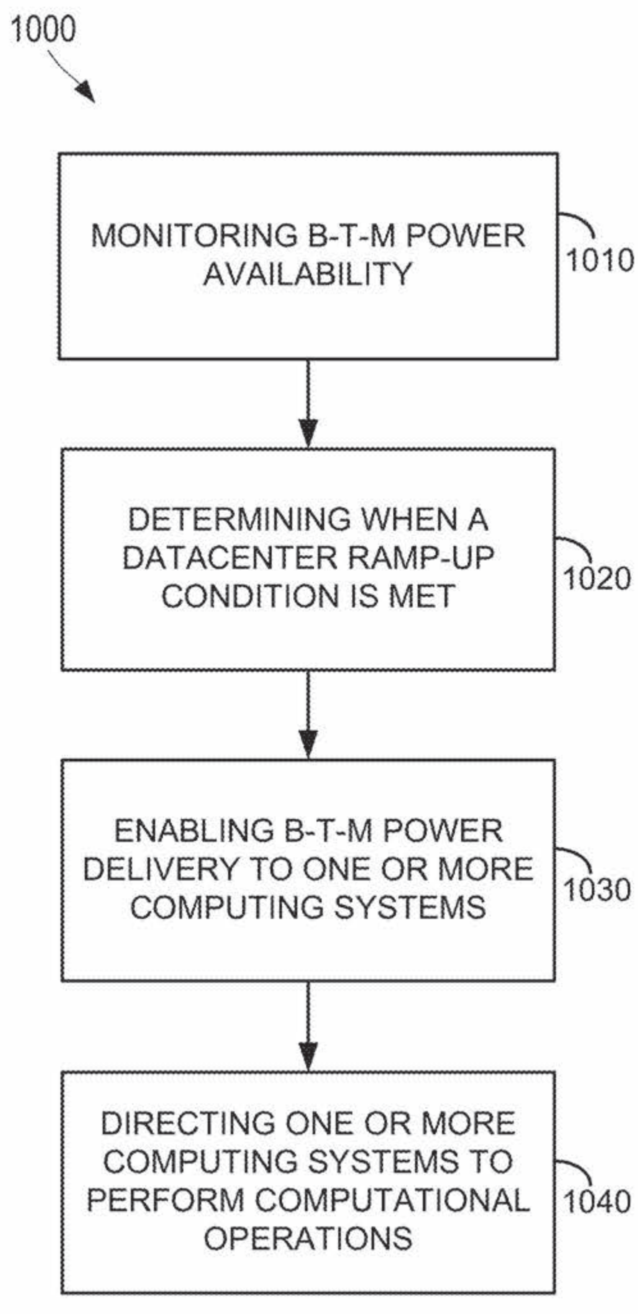
1000
MONITORING B-T-M POWER AVAILABILITY
1010
DETERMINING WHEN A DATACENTER RAMP-UP CONDITION IS MET
1020
ENABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1030
DIRECTING ONE OR MORE COMPUTING SYSTEMS TO PERFORM COMPUTATIONAL OPERATIONS
1040

FIGURE 10A

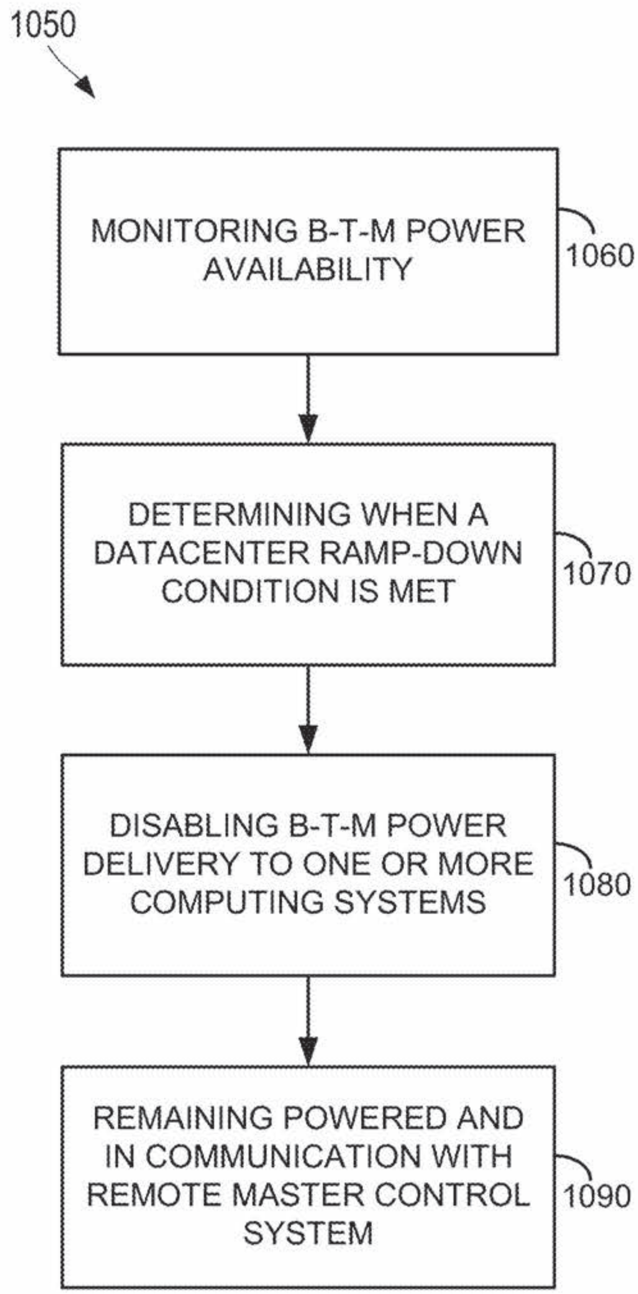
1050
MONITORING B-T-M POWER AVAILABILITY
1060
DETERMINING WHEN A DATACENTER RAMP-DOWN CONDITION IS MET
1070
DISABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1080
REMAINING POWERED AND IN COMMUNICATION WITH REMOTE MASTER CONTROL SYSTEM
1090

FIGURE 10B

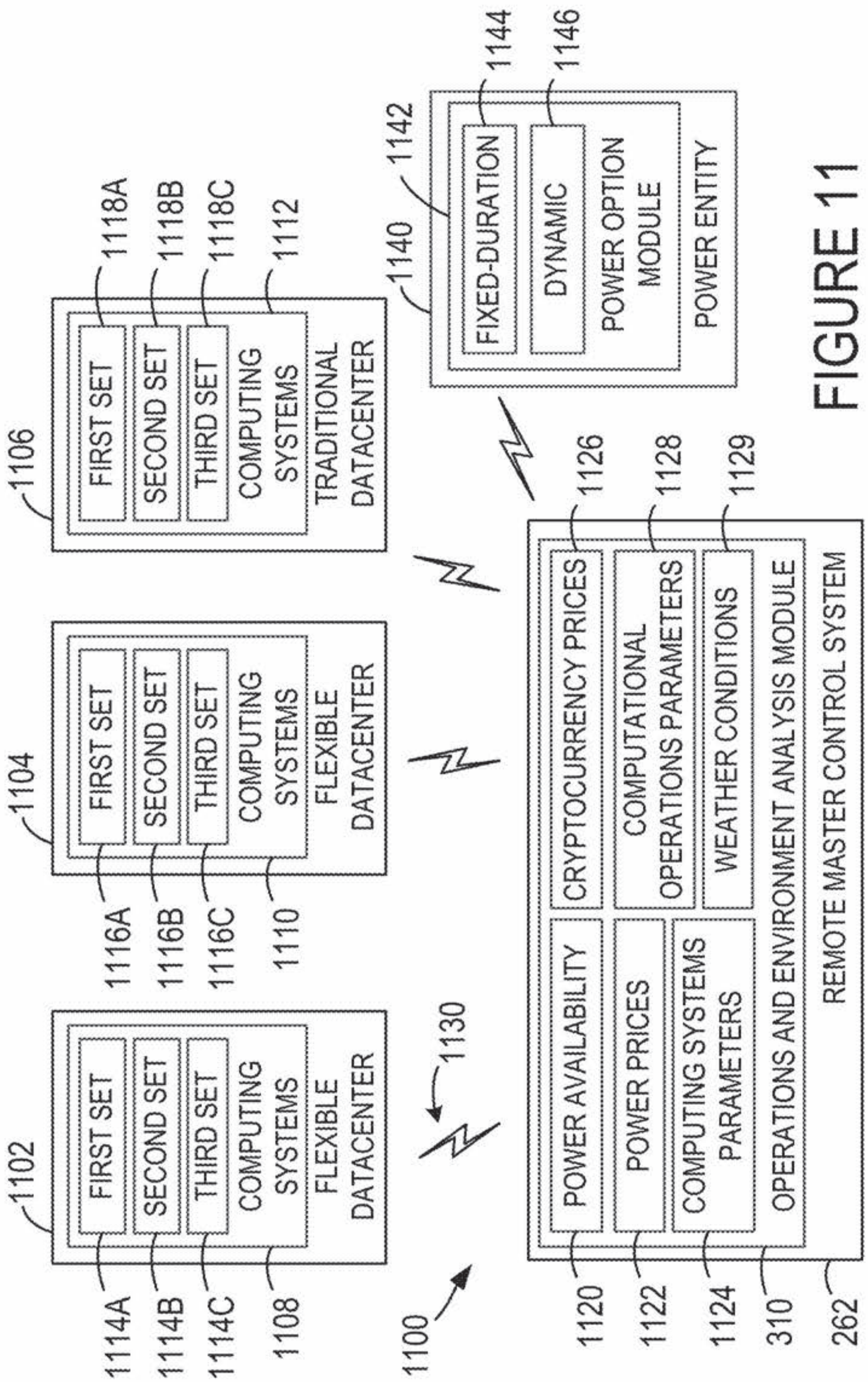
1100
1102
FIRST SET
SECOND SET
THIRD SET
COMPUTING SYSTEMS
FLEXIBLE DATACENTER
1114A
1114B
1114C
1108
1104
1116A
1116B
1116C
1110
1106
TRADITIONAL DATACENTER
1118A
1118B
1118C
1112
1130
POWER AVAILABILITY
POWER PRICES
COMPUTING SYSTEMS PARAMETERS
CRYPTOCURRENCY PRICES
COMPUTATIONAL OPERATIONS PARAMETERS
WEATHER CONDITIONS
OPERATIONS AND ENVIRONMENT ANALYSIS MODULE
REMOTE MASTER CONTROL SYSTEM
1120
1122
1124
310
262
1126
1128
1129
1140
1142
1144
1146
FIXED-DURATION
DYNAMIC
POWER OPTION MODULE
POWER ENTITY

FIGURE 11

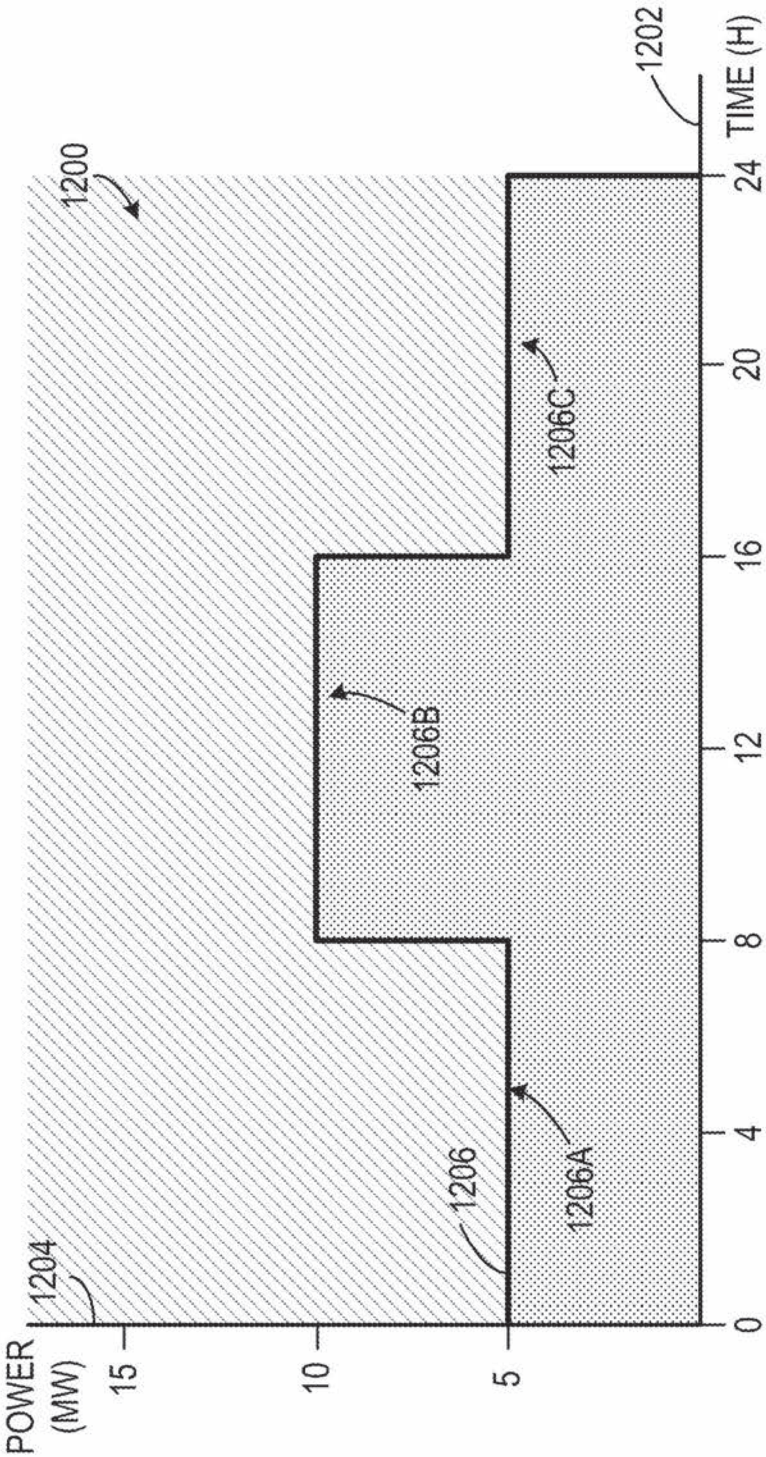
1200
1202
1204
1206
1206A
1206B
1206C
POWER (MW)
15
10
5
TIME (H)
0
4
8
12
16
20
24

FIGURE 12

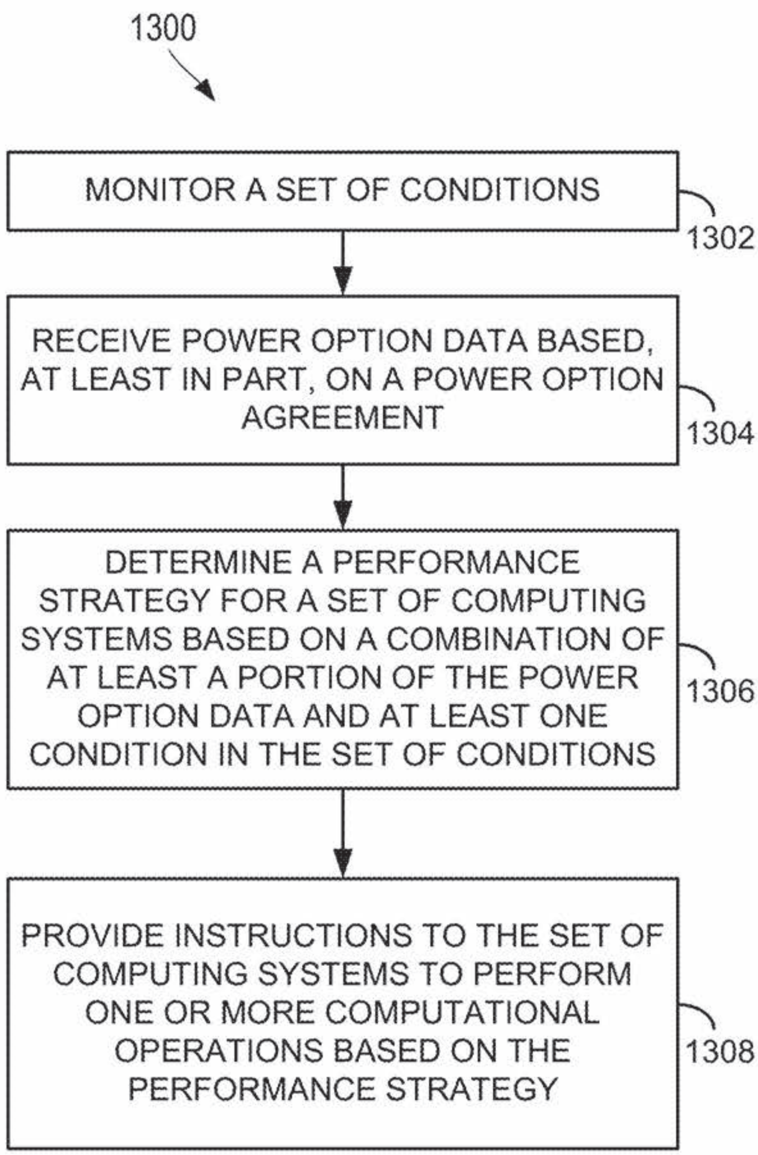
1300
MONITOR A SET OF CONDITIONS
1302
RECEIVE POWER OPTION DATA BASED, AT LEAST IN PART, ON A POWER OPTION AGREEMENT
1304
DETERMINE A PERFORMANCE STRATEGY FOR A SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE POWER OPTION DATA AND AT LEAST ONE CONDITION IN THE SET OF CONDITIONS
1306
PROVIDE INSTRUCTIONS TO THE SET OF COMPUTING SYSTEMS TO PERFORM ONE OR MORE COMPUTATIONAL OPERATIONS BASED ON THE PERFORMANCE STRATEGY
1308

FIGURE 13

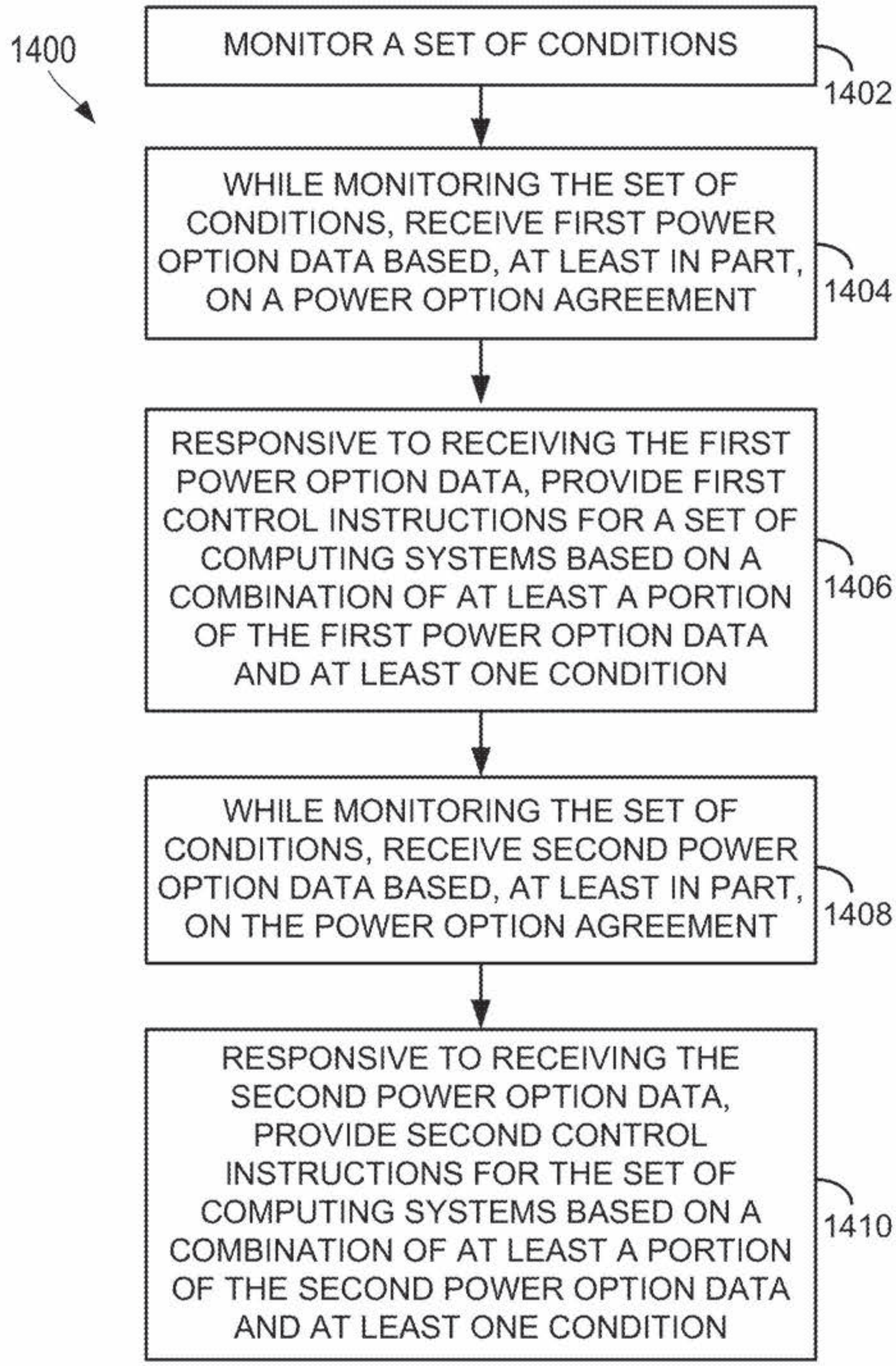
1400
MONITOR A SET OF CONDITIONS
1402
WHILE MONITORING THE SET OF CONDITIONS, RECEIVE FIRST POWER OPTION DATA BASED, AT LEAST IN PART, ON A POWER OPTION AGREEMENT
1404
RESPONSIVE TO RECEIVING THE FIRST POWER OPTION DATA, PROVIDE FIRST CONTROL INSTRUCTIONS FOR A SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE FIRST POWER OPTION DATA AND AT LEAST ONE CONDITION
1406
WHILE MONITORING THE SET OF CONDITIONS, RECEIVE SECOND POWER OPTION DATA BASED, AT LEAST IN PART, ON THE POWER OPTION AGREEMENT
1408
RESPONSIVE TO RECEIVING THE SECOND POWER OPTION DATA, PROVIDE SECOND CONTROL INSTRUCTIONS FOR THE SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE SECOND POWER OPTION DATA AND AT LEAST ONE CONDITION
1410

FIGURE 14

METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Patent Application No. 62/927,119, filed Oct. 28, 2019, the entire contents of which are herein incorporated by reference.

FIELD

This specification relates to power consumption adjustments when using grid power and/or intermittent behind-the-meter power.

BACKGROUND

"Electrical grid" or "grid," as used herein, refers to a Wide Area Synchronous Grid (also known as an Interconnection), and is a regional scale or greater electric power grid that that operates at a synchronized frequency and is electrically tied together during normal system conditions. An electrical grid delivers electricity from generation stations to consumers. An electrical grid includes: (i) generation stations that produce electrical power at large scales for delivery through the grid, (ii) high voltage transmission lines that carry that power from the generation stations to demand centers, and (iii) distribution networks carry that power to individual customers.

FIG. **1** illustrates a typical electrical grid, such as a North American Interconnection or the synchronous grid of Continental Europe (formerly known as the UCTE grid). The electrical grid of FIG. **1** can be described with respect to the various segments that make up the grid.

A generation segment **102** includes one or more generation stations that produce utility-scale electricity (typically >50 MW), such as a nuclear plant **102***a*, a coal plant **102***b*, a wind power station (i.e., wind farm) **102***c*, and/or a photovoltaic power station (i.e., a solar farm) **102***d*. Generation stations are differentiated from building-mounted and other decentralized or local wind or solar power applications because they supply power at the utility level and scale (>50 MW), rather than to a local user or users. The primary purpose of generation stations is to produce power for distribution through the grid, and in exchange for payment for the supplied electricity. Each of the generation stations **102***a-d* includes power generation equipment **102***e-h*, respectively, typically capable of supply utility-scale power (>50 MW). For example, the power generation equipment **102***g* at wind power station **102***c* includes wind turbines, and the power generation equipment **102***h* at photovoltaic power station **102***d* includes photovoltaic panels.

Each of the generation stations **102***a-d* may further include station electrical equipment **102***i***-1** respectively. Station electrical equipment **102***i***-1** are each illustrated in FIG. **1** as distinct elements for simplified illustrative purposes only and may, alternatively or additionally, be distributed throughout the power generation equipment, **102***e-h*, respectively. For example, at wind power station **102***c*, each wind turbine may include transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each wind turbine may be collected by distribution lines along strings of wind turbines and move through collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the wind power station **102***c*. Similarly, at photovoltaic power station **102***d*, individual photovoltaic panels and/or arrays of photovoltaic panels may include inverters, transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each photovoltaic panel and/or array may be collected by distribution lines along the photovoltaic panels and move through collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the photovoltaic power station **102***d*.

Each generation station **102***a-d* may produce AC or DC electrical current which is then typically stepped up to a higher AC voltage before leaving the respective generation station. For example, wind turbines may typically produce AC electrical energy at 600V to 700V, which may then be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***c*. As another example, photovoltaic arrays may produce DC voltage at 600V to 900V, which is then inverted to AC voltage and may be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***d*.

Upon exiting the generation segment **102**, electrical power generated at generation stations **102***a-d* passes through a respective Point of Interconnection ("POI") **103** between a generation station (e.g., **102***a-d*) and the rest of the grid. A respective POI **103** represents the point of connection between a generation station's (e.g. **102***a-d*) equipment and a transmission system (e.g., transmission segment **104**) associated with electrical grid. In some cases, at the POI **103**, generated power from generation stations **102***a-d* may be stepped up at transformer systems **103***e-h* to high voltage scales suitable for long-distance transmission along transmission lines **104***a*. Typically, the generated electrical energy leaving the POI **103** will be at 115 kV AC or above, but in some cases it may be as low as, for example, 69 kV for shorter distance transmissions along transmission lines **104***a*. Each of transformer systems **103***e-h* may be a single transformer or may be multiple transformers operating in parallel or series and may be co-located or located in geographically distinct locations. Each of the transformer systems **103***e-h* may include substations and other links between the generation stations **102***a-d* and the transmission lines **104***a*.

A key aspect of the POI **103** is that this is where generation-side metering occurs. One or more utility-scale generation-side meters **103***a-d* (e.g., settlement meters) are located at settlement metering points at the respective POI **103** for each generation station **102***a-d*. The utility-scale generation-side meters **103***a-d* measure power supplied from generation stations **102***a-d* into the transmission segment **104** for eventual distribution throughout the grid.

For electricity consumption, the price consumers pay for power distributed through electric power grids is typically composed of, among other costs, Generation, Administration, and Transmission & Distribution ("T&D") costs. T&D costs represent a significant portion of the overall price paid by consumers for electricity. These costs include capital costs (land, equipment, substations, wire, etc.), costs associated with electrical transmission losses, and operation and maintenance costs.

For utility-scale electricity supply, operators of generation stations (e.g., **102***a-d*) are paid a variable market price for the amount of power the operator generates and provides to the grid, which is typically determined via a power purchase agreement (PPA) between the generation station operator and a grid operator. The amount of power the generation station operator generates and provides to the grid is measured by utility-scale generation-side meters (e.g., **103***a-d*) at settlement metering points. As illustrated in FIG. **1**, the utility-scale generation-side meters **103***a-d* are shown on a low side of the transformer systems **103***e-h*), but they may alternatively be located within the transformer systems **103***e-h* or on the high side of the transformer systems **103***e-h*. A key aspect of a utility-scale generation-side meter is that it is able to meter the power supplied from a specific generation station into the grid. As a result, the grid operator can use that information to calculate and process payments for power supplied from the generation station to the grid. That price paid for the power supplied from the generation station is then subject to T&D costs, as well as other costs, in order to determine the price paid by consumers.

After passing through the utility-scale generation-side meters in the POI **103**, the power originally generated at the generation stations **102***a-d* is transmitted onto and along the transmission lines **104***a* in the transmission segment **104**. Typically, the electrical energy is transmitted as AC at 115 kV+ or above, though it may be as low as 69 kV for short transmission distances. In some cases, the transmission segment **104** may include further power conversions to aid in efficiency or stability. For example, transmission segment **104** may include high-voltage DC ("HVDC") portions (along with conversion equipment) to aid in frequency synchronization across portions of the transmission segment **104**. As another example, transmission segment **104** may include transformers to step AC voltage up and then back down to aid in long distance transmission (e.g., 230 kV, 500 kV, 765 kV, etc.).

Power generated at the generation stations **104***a-d* is ultimately destined for use by consumers connected to the grid. Once the energy has been transmitted along the transmission segment **104**, the voltage will be stepped down by transformer systems **105***a-c* in the step down segment **105** so that it can move into the distribution segment **106**.

In the distribution segment **106**, distribution networks **106***a-c* take power that has been stepped down from the transmission lines **104***a* and distribute it to local customers, such as local sub-grids (illustrated at **106***a*), industrial customers, including large EV charging networks (illustrated at **106***b*), and/or residential and retail customers, including individual EV charging stations (illustrated at **106***c*). Customer meters **106***d*, **106***f* measure the power used by each of the grid-connected customers in distribution networks **106***a-c*. Customer meters **106***d* are typically load meters that are unidirectional and measure power use. Some of the local customers in the distribution networks **106***a-d* may have local wind or solar power systems **106***e* owned by the customer. As discussed above, these local customer power systems **106***e* are decentralized and supply power directly to the customer(s). Customers with decentralized wind or solar power systems **106***e* may have customer meters **106***f* that are bidirectional or net-metering meters that can track when the local customer power systems **106***e* produce power in excess of the customer's use, thereby allowing the utility to provide a credit to the customer's monthly electricity bill. Customer meters **106***d*, **106***f* differ from utility-scale generation-side meters (e.g., settlement meters) in at least the following characteristics: design (electro-mechanical or electronic vs current transformer), scale (typically less than 1600 amps vs. typically greater than 50 MW; typically less than 600V vs. typically greater than 14 kV), primary function (use vs. supply metering), economic purpose (credit against use vs payment for power), and location (in a distribution network at point of use vs. at a settlement metering point at a Point of Interconnection between a generation station and a transmission line).

To maintain stability of the grid, the grid operator strives to maintain a balance between the amount of power entering the grid from generation stations (e.g., **102***a-d*) and the amount of grid power used by loads (e.g., customers in the distribution segment **106**). In order to maintain grid stability and manage congestion, grid operators may take steps to reduce the supply of power arriving from generation stations (e.g., **102***a-d*) when necessary (e.g., curtailment). Particularly, grid operators may decrease the market price paid for generated power to dis-incentivize generation stations (e.g., **102***a-d*) from generating and supplying power to the grid. In some cases, the market price may even go negative such that generation station operators must pay for power they allow into the grid. In addition, some situations may arise where grid operators explicitly direct a generation station (e.g., **102***a-d*) to reduce or stop the amount of power the station is supplying to the grid.

Power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and operational directives resulting in reduced or discontinued generation all can have disparate effects on renewal energy generators and can occur multiple times in a day and last for indeterminate periods of time. Curtailment, in particular, is particularly problematic.

According to the National Renewable Energy Laboratory's Technical Report TP-6A20-60983 (March 2014):

> [C]urtailment [is] a reduction in the output of a generator from what it could otherwise produce given available resources (e.g., wind or sunlight), typically on an involuntary basis. Curtailments can result when operators or utilities command wind and solar generators to reduce output to minimize transmission congestion or otherwise manage the system or achieve the optimal mix of resources. Curtailment of wind and solar resources typically occurs because of transmission congestion or lack of transmission access, but it can also occur for reasons such as excess generation during low load periods that could cause baseload generators to reach minimum generation thresholds, because of voltage or interconnection issues, or to maintain frequency requirements, particularly for small, isolated grids. Curtailment is one among many tools to maintain system energy balance, which can also include grid capacity, hydropower and thermal generation, demand response, storage, and institutional changes. Deciding which method to use is primarily a matter of economics and operational practice.
>
> "Curtailment" today does not necessarily mean what it did in the early 2000s. Two separate changes in the electric sector have shaped curtailment practices since that time: the utility-scale deployment of wind power, which has no fuel cost, and the evolution of wholesale power markets. These simultaneous changes have led to new operational challenges but have also expanded the array of market-based tools for addressing them.
>
> Practices vary significantly by region and market design. In places with centrally-organized wholesale power markets and experience with wind power, manual wind energy curtailment processes are increasingly being

replaced by transparent offer-based market mechanisms that base dispatch on economics. Market protocols that dispatch generation based on economics can also result in renewable energy plants generating less than what they could potentially produce with available wind or sunlight. This is often referred to by grid operators by other terms, such as "downward dispatch." In places served primarily by vertically integrated utilities, power purchase agreements (PPAs) between the utility and the wind developer increasingly contain financial provisions for curtailment contingencies.

Some reductions in output are determined by how a wind operator values dispatch versus non-dispatch. Other curtailments of wind are determined by the grid operator in response to potential reliability events. Still other curtailments result from overdevelopment of wind power in transmission-constrained areas.

Dispatch below maximum output (curtailment) can be more of an issue for wind and solar generators than it is for fossil generation units because of differences in their cost structures. The economics of wind and solar generation depend on the ability to generate electricity whenever there is sufficient sunlight or wind to power their facilities.

Because wind and solar generators have substantial capital costs but no fuel costs (i.e., minimal variable costs), maximizing output improves their ability to recover capital costs. In contrast, fossil generators have higher variable costs, such as fuel costs. Avoiding these costs can, depending on the economics of a specific generator, to some degree reduce the financial impact of curtailment, especially if the generator's capital costs are included in a utility's rate base.

Curtailment may result in available energy being wasted because solar and wind operators have zero variable cost (which may not be true to the same extent for fossil generation units which can simply reduce the amount of fuel that is being used). With wind generation, in particular, it may also take some time for a wind farm to become fully operational following curtailment. As such, until the time that the wind farm is fully operational, the wind farm may not be operating with optimum efficiency and/or may not be able to provide power to the grid.

SUMMARY

In an example, a system includes a set of computing systems. The set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and, while monitoring the set of conditions, receive first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The control system is further configured to provide first control instructions for the set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions responsive to receiving the first power option data. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The control system is also configured to, while monitoring the set of conditions, receive second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. Responsive to receiving the second power option data, the control system is configured to provide second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and wherein the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In another example, a method involves monitoring, at a computing system, a set of conditions, and while monitoring the set of conditions, receiving first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The method further involves, responsive to receiving the first power option data, providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The method further involves, while monitoring the set of conditions, receiving second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. The method also involves, responsive to receiving the second power option data, providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In yet another example, a system is provided. The system includes a set of computing systems, where the set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and receive power option data based, at least in part, on a power option agreement. The power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, where each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals. The control system is further configured to, responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, where each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The control system is also configured to provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

In a further example, non-transitory computer-readable medium is described that is configured to store instructions,

that when executed by a computing system, causes the computing system to perform operations consistent with the method steps described above.

Other aspects of the present invention will be apparent from the following description and claims.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** shows a typical electrical grid.

FIG. **2** shows a behind-the-meter arrangement with optional grid power, including one or more flexible datacenters, according to one or more example embodiments.

FIG. **3** shows a block diagram of a remote master control system, according to one or more example embodiments.

FIG. **4** a block diagram of a generation station, according to one or more example embodiments.

FIG. **5** shows a block diagram of a flexible datacenter, according to one or more example embodiments.

FIG. **6**A shows a structural arrangement of a flexible datacenter, according to one or more example embodiments.

FIG. **6**B shows a set of computing systems arranged in a straight configuration, according to one or more example embodiments.

FIG. **7** shows a control distribution system for a flexible datacenter, according to one or more example embodiments.

FIG. **8** shows a control distribution system for a fleet of flexible datacenters, according to one or more example embodiments.

FIG. **9** shows a queue distribution system for a traditional datacenter and a flexible datacenter, according to one or more example embodiments.

FIG. **10**A shows a method of dynamic power consumption at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **10**B shows a method of dynamic power delivery at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **11** shows a block diagram of a system for implementing power consumption adjustments based on a power option agreement, according to one or more embodiments.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments.

FIG. **13** shows a method for implementing power consumption adjustments based on a fixed-duration power option agreement, according to one or more embodiments.

FIG. **14** shows a method for implementing power consumption adjustments based on a dynamic power option agreement, according to one or more embodiments.

DETAILED DESCRIPTION

Disclosed examples will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all of the disclosed examples are shown. Different examples may be described and should not be construed as limited to the examples set forth herein.

As discussed above, the market price paid to generation stations for supplying power to the grid often fluctuates due to various factors, including the need to maintain grid stability and based on current demand and usage by connected loads in distribution networks. Due to these factors, situations can arise where generation stations are offered substantially lower prices to deter an over-supply of power to the grid. Although these situations typically exist temporarily, generation stations are sometimes forced to either sell power to the grid at the much lower prices or adjust operations to decrease the amount of power generated. Furthermore, some situations may even require generation stations to incur costs in order to offload power to the grid or to shut down generation temporarily.

The volatility in the market price offered for power supplied to the grid can be especially problematic for some types of generation stations. In particular, wind farms and some other types of renewable resource power producers may lack the ability to quickly adjust operations in response to changes in the market price offered for supplying power to the grid. As a result, power generation and management at some generation stations can be inefficient, which can frequently result in power being sold to the grid at low or negative prices. In some situations, a generation station may even opt to halt power generation temporarily to avoid such unfavorable pricing. As such, the time required to halt and to restart the power generation at a generation station can reduce the generation station's ability to take advantage of rising market prices for power supplied to the grid.

Example embodiments provided herein aim to assist generation stations in managing power generation operations and avoid unfavorable power pricing situations like those described above. In particular, example embodiments may involve providing a load that is positioned behind-the-meter ("BTM") and enabling the load to utilize power received behind-the-meter at a generation station in a timely manner. As a general rule of thumb, BTM power is not subject to traditional T&D costs.

For purposes herein, a generation station is considered to be configured for the primary purpose of generating utility-scale power for supply to the electrical grid (e.g., a Wide Area Synchronous Grid or a North American Interconnect).

In one embodiment, equipment located behind-the-meter ("BTM equipment") is equipment that is electrically connected to a generation station's power generation equipment behind (i.e., prior to) the generation station's POI with an electrical grid.

In one embodiment, behind-the-meter power ("BTM power") is electrical power produced by a generation station's power generation equipment and utilized behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM equipment receives power from the generation station, but the power received by the BTM equipment from the generation station has not passed through the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM power is utilized before being metered at the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that supplies power to a grid, and the BTM equipment receives power from the generation station that is not subject to T&D charges, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that supplies power to a grid, and the BTM power is not subject to T&D charges before being used by electrical equipment, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, equipment may be considered behind-the-meter if the BTM equipment receives power generated from the generation station and that received power is not routed through the electrical grid before being delivered to the BTM equipment.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station, and BTM equipment receives that generated power, and that generated power received by the BTM equipment is not routed through the electrical grid before being delivered to the BTM equipment.

For purposes herein, BTM equipment may also be referred to as a behind-the-meter load ("BTM load") when the BTM equipment is actively consuming BTM power.

Beneficially, where BTM power is not subject to traditional T&D costs, a wind farm or other type of generation station can be connected to BTM loads which can allow the generation station to selectively avoid the adverse or less-than optimal cost structure occasionally associated with supplying power to the grid by shunting generated power to the BTM load.

An arrangement that positions and connects a BTM load to a generation station can offer several advantages. In such arrangements, the generation station may selectively choose whether to supply power to the grid or to the BTM load, or both. The operator of a BTM load may pay to utilize BTM power at a cost less than that charged through a consumer meter (e.g., **106***d*, **1060** located at a distribution network (e.g., **106***a-c*) receiving power from the grid. The operator of a BTM load may additionally or alternatively charge less than the market rate to consume excess power generated at the generation station during curtailment. As a result, the generation station may direct generated power based on the "best" price that the generation station can receive during a given time frame, and/or the lowest cost the generation station may incur from negative market pricing during curtailment. The "best" price may be the highest price that the generation station may receive for its generated power during a given duration, but can also differ within embodiments and may depend on various factors, such as a prior PPA.

In one example, by having a behind-the-meter option available, a generation station may transition from supplying all generated power to the grid to supplying some or all generated power to one or more BTM loads when the market price paid for power by grid operators drops below a predefined threshold (e.g., the price that the operator of the BTM load is willing to pay the generation station for power). Thus, by having an alternative option for power consumption (i.e., one or more BTM loads), the generation station can selectively utilize the different options to maximize the price received for generated power. In addition, the generation station may also utilize a BTM load to avoid or reduce the economic impact in situations when supplying power to the grid would result in the generation station incurring a net cost.

Providing BTM power to a load can also benefit the BTM load operator. A BTM load may be able to receive and utilize BTM power received from the generation station at a cost that is lower than the cost for power from the grid (e.g., at a customer meter **106***d*, **1060**. This is primarily due to the avoidance (or significant reduction) in T&D costs and the market effects of curtailment. As indicated above, the generation station may be willing to divert generated power to the BTM load rather than supplying the grid due to changing market conditions, or during maintenance periods, or for other non-market conditions. Thus, some situations may arise where the generation station offers power to the BTM load at a price that is substantially lower than the price available on the grid. Furthermore, in some situations, the BTM load may even be able to obtain and utilize BTM power from a generation station at no cost or even at negative pricing since the generation station may rather supply the BTM load with generated power during a given time range instead of paying a higher price for the grid to take the power or modifying operations to decrease power output.

Another example of cost-effective use of BTM power is when the generation station **202** is selling power to the grid at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price the generation station **202** would have to pay to the grid power to offload generation's station **202** generated power. Advantageously, one or more flexible datacenters **220** may take the generated power behind-the-meter, thereby allowing the generation station **202** to produce and obtain the production tax credit, while selling less power to the grid at the negative price.

Another example of cost-effective behind-the-meter power is when the generation station **202** is selling power to the grid at a negative price because the grid is oversupplied and/or the generation station **202** is instructed to stand down and stop producing altogether. A grid operator may select and direct certain generation stations to go offline and stop supplying power to the grid. Advantageously, one or more flexible datacenters may be used to take power behind-the-meter, thereby allowing the generation station **202** to stop supplying power to the grid, but still stay online and make productive use of the power generated.

Another example of beneficial behind-the-meter power use is when the generation station **202** is producing power that is, with reference to the grid, unstable, out of phase, or at the wrong frequency, or the grid is already unstable, out of phase, or at the wrong frequency. A grid operator may select certain generation stations to go either offline and stop producing power, or to take corrective action with respect to the grid power stability, phase, or frequency. Advantageously, one or more flexible datacenters **220** may be used to selectively consume power behind-the-meter, thereby allowing the generation station **202** to stop providing power to the grid and/or provide corrective feedback to the grid.

Another example of beneficial behind-the-meter power use is that cost-effective behind-the-meter power availability may occur when the generation station **202** is starting up or testing. Individual equipment in the power generation equipment **210** may be routinely offline for installation, maintenance, and/or service and the individual units must be tested prior to coming online as part of overall power generation equipment **210**. During such testing or maintenance time, one or more flexible datacenters may be intermittently

powered by the one or more units of the power generation equipment **210** that are offline from the overall power generation equipment **210**.

Another example of beneficial behind-the-meter power use is that datacenter control systems at the flexible datacenters **220** may quickly ramp up and ramp down power consumption by computing systems in the flexible datacenters **220** based on power availability from the generation station **202**. For instance, if the grid requires additional power and signals the demand via a higher local price for power, the generation station **202** can supply the grid with power nearly instantly by having active flexible datacenters **220** quickly ramp down and turn off computing systems (or switch to a stored energy source), thereby reducing an active BTM load.

Another example of beneficial behind-the-meter power use is in new photovoltaic generation stations **202**. For example, it is common to design and build new photovoltaic generation stations with a surplus of power capacity to account for degradation in efficiency of the photovoltaic panels over the life of the generation stations. Excess power availability at the generation station can occur when there is excess local power generation and/or low grid demand. In high incident sunlight situations, a photovoltaic generation station **202** may generate more power than the intended capacity of generation station **202**. In such situations, a photovoltaic generation station **202** may have to take steps to protect its equipment from damage, which may include taking one or more photovoltaic panels offline or shunting their voltage to dummy loads or the ground. Advantageously, one or more flexible datacenters (e.g., the flexible datacenters **220**) may take power behind-the-meter at the Generations Station **202**, thereby allowing the generation station **202** to operate the power generation equipment **210** within operating ranges while the flexible datacenters **220** receive BTM power without transmission or distribution costs.

Thus, for at least the reasons described herein, arrangements that involves providing a BTM load as an alternative option for a generation station to direct its generated power to can serve as a mutually beneficial relationship in which both the generation station and the BTM load can economically benefit. The above-noted examples of beneficial use of BTM power are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as benefits to unutilized BTM power capacity, BTM power pricing, or BTM power consumption.

Within example embodiments described herein, various types of utility-scale power producers may operate as generation stations **202** that are capable of supplying power to one or more loads behind-the-meter. For instance, renewable energy sources (e.g., wind, solar, hydroelectric, wave, water current, tidal), fossil fuel power generation sources (coal, natural gas), and other types of power producers (e.g., nuclear power) may be positioned in an arrangement that enables the intermittent supply of generated power behind-the-meter to one or more BTM loads. One of ordinary skill in the art will recognize that the generation station **202** may vary based on an application or design in accordance with one or more example embodiments.

In addition, the particular arrangement (e.g., connections) between the generation station and one or more BTM loads can vary within examples. In one embodiment, a generation station may be positioned in an arrangement wherein the generation station selectively supplies power to the grid and/or to one or more BTM loads. As such, power cost-analysis and other factors (e.g., predicted weather conditions, contractual obligations, etc.) may be used by the generation station, a BTM load control system, a remote master control system, or some other system or enterprise, to selectively output power to either the grid or to one or more BTM loads in a manner that maximizes revenue to the generation station. In such an arrangement, the generation station may also be able to supply both the grid and one or more BTM loads simultaneously. In some instances, the arrangement may be configured to allow dynamic manipulation of the percentage of the overall generated power that is supplied to each option at a given time. For example, in some time periods, the generation station may supply no power to the BTM load.

In addition, the type of loads that are positioned behind-the-meter can vary within example embodiments. In general, a load that is behind-the-meter may correspond to any type of load capable of receiving and utilizing power behind-the-meter from a generation station. Some examples of loads include, but are not limited to, datacenters and electric vehicle (EV) charging stations.

Preferred BTM loads are loads that can be subject to intermittent power supply because BTM power may be available intermittently. In some instances, the generation station may generate power intermittently. For example, wind power station **102***c* and/or photovoltaic power station **102***d* may only generate power when resource are available or favorable. Additionally or alternatively, BTM power availability at a generation station may only be available intermittently due to power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and/or operational directives from grid operators or generation station operators.

Some example embodiments of BTM loads described herein involve using one or more computing systems to serve as a BTM load at a generation station. In particular, the computing system or computing systems may receive power behind-the-meter from the generation station to perform various computational operations, such as processing or storing information, performing calculations, mining for cryptocurrencies, supporting blockchain ledgers, and/or executing applications, etc.

Multiple computing systems positioned behind-the-meter may operate as part of a "flexible" datacenter that is configured to operate only intermittently and to receive and utilize BTM power to carry out various computational operations similar to a traditional datacenter. In particular, the flexible datacenter may include computing systems and other components (e.g., support infrastructure, a control system) configured to utilize BTM power from one or more generation stations. The flexible datacenter may be configured to use particular load ramping abilities (e.g., quickly increase or decrease power usage) to effectively operate during intermittent periods of time when power is available from a generation station and supplied to the flexible datacenter behind-the-meter, such as during situations when supplying generated power to the grid is not favorable for the generation station.

In some instances, the amount of power consumed by the computing systems at a flexible datacenter can be ramped up and down quickly, and potentially with high granularity (i.e., the load can be changed in small increments if desired). This may be done based on monitored power system conditions or other information analyses as discussed herein. As recited above, this can enable a generation station to avoid negative power market pricing and to respond quickly to grid direc-

tives. And by extension, the flexible datacenter may obtain BTM power at a price lower than the cost for power from the grid.

Various types of computing systems can provide granular power ramping. Preferably, the computing systems can perform computational tasks that are immune to, or not substantially hindered by, frequent interruptions or slow-downs in processing as the computing systems ramp down or up. In some embodiments, a control system may be used to activate or de-activate one or more computing systems in an array of computing systems. For example, the control system may provide control instructions to one or more blockchain miners (e.g., a group of blockchain miners), including instructions for powering on or off, adjusting frequency of computing systems performing operations (e.g., adjusting the processing frequency), adjusting the quantity of operations being performed, and when to operate within a low power mode (if available).

Within examples, a control system may correspond to a specialized computing system or may be a computing system within a datacenter serving in the role of the control system. The location of the control system can vary within examples as well. For instance, the control system may be located at a datacenter or physically separate from the datacenter. In some examples, the control system may be part of a network of control systems that manage computational operations, power consumption, and other aspects of a fleet of datacenters. The fleet of datacenters may include one or more traditional datacenters and/or flexible datacenters.

Some embodiments may involve using one or more control systems to direct time-insensitive (e.g., interruptible) computational tasks to computational hardware, such as central processing units (CPUs) and graphics processing units (GPUs), sited behind the meter, while other hardware is sited in front of the meter (i.e., consuming metered grid power via a customer meter (e.g., **106***d*, **1060**) and possibly remote from the behind-the-meter hardware. As such, parallel computing processes, such as Monte Carlo simulations, batch processing of financial transactions, graphics rendering, machine learning, neural network processing, queued operations, and oil and gas field simulation models, are good candidates for such interruptible computational operations.

FIG. **2** shows a behind-the-meter arrangement with optional grid-power, including one or more flexible datacenters, according to one or more example embodiments. Dark arrows illustrate a typical power delivery direction. Consistent with FIG. **1**, the arrangement illustrates a generation station **202** in the generation segment **102** of a Wide-Area Synchronous Grid. The generation station **202** supplies utility-scale power (typically >50 MW) via a generation power connection **250** to the Point of Interconnection **103** between the generation station **202** and the rest of the grid. Typically, the power supplied on connection **250** may be at 34.5 kV AC, but it may be higher or lower. Depending on the voltage at connection **250** and the voltage at transmission lines **104***a*, a transformer system **203** may step up the power supplied from the generation station **202** to high voltage (e.g., 115 kV+AC) for transmission over connection **252** and onto transmission lines **104***a* of transmission segment **104**. Grid power carried on the transmission segment **104** may be from generation station **202** as well as other generation stations (not shown). Also consistent with FIG. **1**, grid power is consumed at one or more distribution networks, including example distribution network **206**. Grid power may be taken from the transmission lines **104***a* via connector **254** and stepped down to distribution network voltages (e.g., typically 4 kV to 26 kV AC) and sent into the distribution networks, such as distribution network **206** via distribution line **256**. The power on distribution line **256** may be further stepped down (not shown) before entering individual consumer facilities such as a remote master control system **262** and/or traditional datacenters **260** via customer meters **206**A, which may correspond to customer meters **106***d* in FIG. **1**, or customer meters **106***f* in FIG. **1** if the respective consumer facility includes a local customer power system, such as **106***e* (not shown in FIG. **2**).

Consistent with FIG. **1**, power entering the grid from generation station **202** is metered by a utility-scale generation-side meter. A utility-scale generation-side meter **253** is shown on the low side of transformer system **203** and an alternative location is shown as **253**A on the high side of transformer system **203**. Both locations may be considered settlement metering points for the generation station **202** at the POI **103**. Alternatively, a utility-scale generation-side meter for the generation station **202** may be located at another location consistent with the descriptions of such meters provided herein.

Generation station **202** includes power generation equipment **210**, which may include, as examples, wind turbines and/or photovoltaic panels. Power generation equipment **210** may further include other electrical equipment, including but not limited to switches, busses, collectors, inverters, and power unit transformers (e.g., transformers in wind turbines).

As illustrated in FIG. **2**, generation station **202** is configured to connect with BTM equipment which may function as BTM loads. In the illustrated embodiment of FIG. **2**, the BTM equipment includes flexible datacenters **220**. Various configurations to supply BTM power to flexible datacenters **220** within the arrangement of FIG. **2** are described herein.

In one configuration, generated power may travel from the power generation equipment **210** over one or more connectors **230**A, **230**B to one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **230**A, **230**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **230**B is shown with an open switch, and connector **230**A is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used in various embodiments when BTM power is supplied without significant power conversion to BTM loads.

In various configurations, the busses **240**A and **240**B may be separated by an open switch **240**C or combined into a common bus by a closed switch **240**C.

In another configuration, generated power may travel from the power generation equipment **210** to the high side of a local step-down transformer **214**. The generated power may then travel from the low side of the local step-down transformer **214** over one or more connectors **232**A, **232**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **232**A, **232**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **232**A is shown with an open switch, and connector **232**B is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the power generation equipment **210**, but the generated power must be stepped down prior to use at the BTM loads.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of a local step-up transformer **212**. The generated power may

then travel from the high side of the local step-up transformer **212** over one or more connectors **234**A, **234**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **234**A, **234**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **234**A, **234**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of the local step-up transformer **212**. The generated power may then travel from the high side of the local step-up transformer **212** to the high side of local step-down transformer **213**. The generated power may then travel from the low side of the local step-down transformer **213** over one or more connectors **236**A, **236**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **236**A, **2346** may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **236**A, **236**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**, but the power must be stepped down prior to use at the BTM loads.

In one embodiment, power generated at the generation station **202** may be used to power a generation station control system **216** located at the generation station **202**, when power is available. The generation station control system **216** may typically control the operation of the generation station **202**. Generated power used at the generation station control system **216** may be supplied from bus **240**A via connector **216**A and/or from bus **240**B via connector **216**B. Each of the connectors **216**A, **216**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. While the generation station control system **216** can consume BTM power when powered via bus **240**A or bus **240**B, the BTM power taken by generation station control system **216** is insignificant in terms of rendering an economic benefit. Further, the generation station control system **216** is not configured to operate intermittently, as it generally must remain always on. Further still, the generation station control system **216** does not have the ability to quickly ramp a BTM load up or down.

In another embodiment, grid power may alternatively or additionally be used to power the generation station control system **216**. As illustrated here, metered grid power from a distribution network, such as distribution network **206** for simplicity of illustration purposes only, may be used to power generation station control system **216** over connector **216**C. Connector **216**C may be a switched connector so that metered grid power to the generation station control system **216** can be switched on or off as needed. More commonly, metered grid power would be delivered to the generation station control system **216** via a separate distribution network (not shown), and also over a switched connector. Any such grid power delivered to the generation station control system **216** is metered by a customer meter **206**A and subject to T&D costs.

In another embodiment, when power generation equipment **210** is in an idle or off state and not generating power, grid power may backfeed into generation station **202** through POI **103** and such grid power may power the generation station control system **216**.

In some configurations, an energy storage system **218** may be connected to the generation station **202** via connector **218**A, which may be a switched connector. For illustrative purposes only, connector **218**A is shown with an open switch but in some embodiments it may be closed. The energy storage system **218** may be connected to bus **240**A and/or bus **240**B and store energy produced by the power generation equipment **210**. The energy storage system may also be isolated from generation station **202** by switch **242**A. In times of need, such as when the power generation equipment in an idle or off state and not generating power, the energy storage system may feed power to, for example, the flexible datacenters **220**. The energy storage system may also be isolated from the flexible datacenters **220** by switch **242**B.

In a preferred embodiment, as illustrated, power generation equipment **210** supplies BTM power via connector **242** to flexible datacenters **220**. The BTM power used by the flexible datacenters **220** was generated by the generation station **202** and did not pass through the POI **103** or utility-scale generation-side meter **253**, and is not subject to T&D charges. Power received at the flexible datacenters **220** may be received through respective power input connectors **220**A. Each of the respective connectors **220**A may be switched connector that can electrically isolate the respective flexible datacenter **220** from the connector **242**. Power equipment **220**B may be arranged between the flexible datacenters **220** and the connector **242**. The power equipment **220**B may include, but is not limited to, power conditioners, unit transformers, inverters, and isolation equipment. As illustrated, each flexible datacenter **220** may be served by a respective power equipment **220**B. However, in another embodiment, one power equipment **220**B may serve multiple flexible datacenter **220**.

In one embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter and electrically connected to the power generation equipment **210** behind (i.e., prior to) the generation station's POI **103** with the rest of the electrical grid.

In one embodiment, BTM power produced by the power generation equipment **210** is utilized by the flexible datacenters **220** behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter as the flexible datacenters **220** are electrically connected to the generation station **202**, and generation station **202** is subject to metering by utility-scale generation-side meter **253** (or **253**A, or another utility-scale generation-side meter), and the flexible datacenters **220** receive power from the generation station **202**, but the power received by the flexible datacenters **220** from the generation station **202** has not passed through a utility-scale generation-side meter. In this embodiment, the utility-scale generation-side meter **253** (or **253**A) for the generation station **202** is located at the generation station's **202** POI **103**. In another embodiment, the utility-scale generation-side meter for the generation station **202** is at a location other than the POI for the generation station **202**—for example, a substation (not shown) between the generation station **202** and the generation station's POI **103**.

In another embodiment, power from the generation station **202** is supplied to the flexible datacenters **220** as BTM power, where power produced at the generation station **202** is subject to metering by utility-scale generation-side meter

253 (or 253A, or another utility-scale generation-side meter), but the BTM power supplied to the flexible datacenters 220 is utilized before being metered at the utility-scale generation-side meter 253 (or 253A, or another utility-scale generation-side meter). In this embodiment, the utility-scale generation-side meter 253 (or 253A) for the generation station 202 is located at the generation station's 202 POI 103. In another embodiment, the utility-scale generation-side meter for the generation station 202 is at a location other than the POI for the generation station 202—for example, a substation (not shown) between the generation station 202 and the generation station's POI 103.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter as they are electrically connected to the generation station 202 that supplies power to the grid, and the flexible datacenters 220 receive power from the generation station 202 that is not subject to T&D charges, but power otherwise received from the grid that is supplied by the generation station 202 is subject to T&D charges.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 that supplies power to a grid, and the generated power is not subject to T&D charges before being used by flexible datacenters 220, but power otherwise received from the connected grid is subject to T&D charges.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter because they receive power generated from the generation station 202 intended for the grid, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 for distribution to the grid, and the flexible datacenters 220 receive that power, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, metered grid power may alternatively or additionally be used to power one or more of the flexible datacenters 220, or a portion within one or more of the flexible datacenters 220. As illustrated here for simplicity, metered grid power from a distribution network, such as distribution network 206, may be used to power one or more flexible datacenters 220 over connector 256A and/or 256B. Each of connector 256A and/or 256B may be a switched connector so that metered grid power to the flexible datacenters 220 can be switched on or off as needed. More commonly, metered grid power would be delivered to the flexible datacenters 220 via a separate distribution network (not shown), and also over switched connectors. Any such grid power delivered to the flexible datacenters 220 is metered by customer meters 206A and subject to T&D costs. In one embodiment, connector 256B may supply metered grid power to a portion of one or more flexible datacenters 220. For example, connector 256B may supply metered grid power to control and/or communication systems for the flexible datacenters 220 that need constant power and cannot be subject to intermittent BTM power. Connector 242 may supply solely BTM power from the generation station 202 to high power demand computing systems within the flexible datacenters 220, in which case at least a portion of each flexible datacenters 220 so connected is operating as a BTM load. In another embodiment, connector 256A and/or 256B may supply all power used at one or more of the flexible datacenters 220, in which case each of the flexible datacenters 220 so connected would not be operating as a BTM load.

In another embodiment, when power generation equipment 210 is in an idle or off state and not generating power, grid power may backfeed into generation station 202 through POI 103 and such grid power may power the flexible datacenters 220.

The flexible datacenters 220 are shown in an example arrangement relative to the generation station 202. Particularly, generated power from the generation station 202 may be supplied to the flexible datacenters 220 through a series of connectors and/or busses (e.g., 232B, 240B, 242, 220A). As illustrated, in other embodiments, connectors between the power generation equipment 210 and other components may be switched open or closed, allowing other pathways for power transfer between the power generation equipment 210 and components, including the flexible datacenters 220. Additionally, the connector arrangement shown is illustrative only and other circuit arrangements are contemplated within the scope of supplying BTM power to a BTM load at generation station 202. For example, there may be more or fewer transformers, or one or more of transformers 212, 213, 214 may be transformer systems with multiple steppings and/or may include additional power equipment including but not limited to power conditioners, filters, switches, inverters, and/or AC/DC-DC/AC isolators. As another example, metered grid power connections to flexible datacenters 220 are shown via both 256A and 256B; however, a single connection may connect one or more flexible datacenters 220 (or power equipment 220B) to metered grid power and the one or more flexible datacenters 220 (or power equipment 220B) may include switching apparatus to direct BTM power and/or metered grid power to control systems, communication systems, and/or computing systems as desired.

In some examples, BTM power may arrive at the flexible datacenters 220 in a three-phase AC format. As such, power equipment (e.g., power equipment 220B) at one or more of the flexible datacenters 220 may enable each flexible datacenter 220 to use one or more phases of the power. For instance, the flexible datacenters 220 may utilize power equipment (e.g., power equipment 220B, or alternatively or additionally power equipment that is part of the flexible datacenter 220) to convert BTM power received from the generation station 202 for use at computing systems at each flexible datacenter 220. In other examples, the BTM power may arrive at one or more of the flexible datacenters 220 as DC power. As such, the flexible datacenters 220 may use the DC power to power computing systems. In some such examples, the DC power may be routed through a DC-to-DC converter that is part of power equipment 220B and/or flexibles datacenter 220.

In some configurations, a flexible datacenter 220 may be arranged to only have access to power received behind-the-meter from a generation station 202. In the arrangement of FIG. 2, the flexible datacenters 220 may be arranged only with a connection to the generation station 202 and depend solely on power received behind-the-meter from the generation station 202. Alternatively or additionally, the flexible datacenters 220 may receive power from energy storage system 218.

In some configurations, one or more of the flexible datacenters 220 can be arranged to have connections to multiple sources that are capable of supplying power to a flexible datacenter 220. To illustrate a first example, the flexible datacenters 220 are shown connected to connector 242, which can be connected or disconnected via switches to

the energy storage system **218** via connector **218**A, the generation station **202** via bus **240**B, and grid power via metered connector **256**A. In one embodiment, the flexible datacenters **220** may selectively use power received behind-the-meter from the generation station **202**, stored power supplied by the energy storage system **218**, and/or grid power. For instance, flexible datacenters **220** may use power stored in the energy storage system **218** when costs for using power supplied behind-the-meter from the generation station **202** are disadvantageous. By having access to the energy storage system **218** available, the flexible datacenters **220** may use the stored power and allow the generation station **202** to subsequently refill the energy storage system **218** when cost for power behind-the-meter is low. Alternatively, the flexible datacenters **220** may use power from multiple sources simultaneously to power different components (e.g., a first set and a second set of computing systems). Thus, the flexible datacenters **220** may leverage the multiple connections in a manner that can reduce the cost for power used by the computing systems at the flexible datacenters **220**. The flexible datacenters **220** control system or the remote master control system **262** may monitor power conditions and other factors to determine whether the flexible datacenters **220** should use power from either the generation station **202**, grid power, the energy storage system **218**, none of the sources, or a subset of sources during a given time range. Other arrangements are possible as well. For example, the arrangement of FIG. **2** illustrates each flexible datacenter **220** as connected via a single connector **242** to energy storage system **218**, generation station **202**, and metered grid power via **256**A. However, one or more flexible datacenters **220** may have independent switched connections to each energy source, allowing the one or more flexible datacenters **220** to operate from different energy sources than other flexible datacenters **220** at the same time.

The selection of which power source to use at a flexible datacenter (e.g., the flexible datacenters **220**) or another type of BTM load can change based on various factors, such as the cost and availability of power from both sources, the type of computing systems using the power at the flexible datacenters **220** (e.g., some systems may require a reliable source of power for a long period), the nature of the computational operations being performed at the flexible datacenters **220** (e.g., a high priority task may require immediate completion regardless of cost), and temperature and weather conditions, among other possible factors. As such, a datacenter control system at the flexible datacenters **220**, the remote master control system **262**, or another entity (e.g., an operator at the generation station **202**) may also influence and/or determine the source of power that the flexible datacenters **220** use at a given time to complete computational operations.

In some example embodiments, the flexible datacenters **220** may use power from the different sources to serve different purposes. For example, the flexible datacenters **220** may use metered power from grid power to power one or more systems at the flexible datacenters **220** that are configured to be always-on (or almost always on), such as a control and/or communication system and/or one or more computing systems (e.g., a set of computing systems performing highly important computational operations). The flexible datacenters **220** may use BTM power to power other components within the flexible datacenters **220**, such as one or more computing systems that perform less critical computational operations.

In some examples, one or more flexible datacenters **220** may be deployed at the generation station **202**. In other examples, flexible datacenters **220** may be deployed at a location geographically remote from the generation station **202**, while still maintaining a BTM power connection to the generation station **202**.

In another example arrangement, the generation station **202** may be connected to a first BTM load (e.g., a flexible datacenter **220**) and may supply power to additional BTM loads via connections between the first BTM load and the additional BTM loads (e.g., a connection between a flexible datacenter **220** and another flexible datacenter **220**).

The arrangement in FIG. **2**, and components included therein, are for non-limiting illustration purposes and other arrangements are contemplated in examples. For instance, in another example embodiment, the arrangement of FIG. **2** may include more or fewer components, such as more BTM loads, different connections between power sources and loads, and/or a different number of datacenters. In addition, some examples may involve one or more components within the arrangement of FIG. **2** being combined or further divided.

Within the arrangement of FIG. **2**, a control system, such as the remote master control system **262** or another component (e.g., a control system associated with the grid operator, the generation station control system **216**, or a datacenter control system associated with a traditional datacenter or one or more flexible datacenters) may use information to efficiently manage various operations of some of the components within the arrangement of FIG. **2**. For example, the remote master control system **262** or another component may manage distribution and execution of computational operations at one or more traditional datacenters **260** and/or flexible datacenters **220** via one or more information-processing algorithms. These algorithms may utilize past and current information in real-time to manage operations of the different components. These algorithms may also make some predictions based on past trends and information analysis. In some examples, multiple computing systems may operate as a network to process information.

Information used to make decisions may include economic and/or power-related information, such as monitored power system conditions. Monitored power system conditions may include one or more of excess power generation at a generation station **202**, excess power at a generation station **202** that a connected grid cannot receive, power generation at a generation station **202** subject to economic curtailment, power generation at a generation station **202** subject to reliability curtailment, power generation at a generation station **202** subject to power factor correction, low power generation at a generation station **202**, start up conditions at a generation station **202**, transient power generation conditions at a generation station **202**, or testing conditions where there is an economic advantage to using behind-the-meter power generation at a generation station **202**. These different monitored power system conditions can be weighted differently during processing and analysis.

In some examples, the information can include the cost for power from available sources (e.g., BTM power at the generation station **202** versus metered grid power) to enable comparisons to be made which power source costs less. In some instances, the information may include historic prices for power to enable the remote master control system **262** or another system to predict potential future prices in similar situations (e.g., the cost of power tends to trend upwards for grid power during warmer weather and peak-use hours). The information may also indicate the availability of power from the various sources (e.g., BTM power at the generation

station 262, the energy storage system 218 at the generation station 262, and/or metered grid power).

In addition, the information may also include other data, including information associated with operations at components within the arrangement. For instance, the information may include data associated with performance of operations at the flexible datacenters 220 and the traditional datacenters 260, such as the number of computational tasks currently being performed, the types of tasks being performed (e.g., type of computational operation, time-sensitivity, etc.), the number, types, and capabilities of available computing systems, the amount of computational tasks awaiting performance, and the types of computing systems at one or more datacenters, among others. The information may also include data specifying the conditions at one or more datacenters (e.g., whether or not the temperatures are in a desired range, the amount of power available within an energy storage system such as 218), the amount of computational tasks awaiting performance in the queue of one or more of the datacenters, and the identities of the entities associated with the computational operations at one or more of the datacenters. Entities associated with computational operations may be, for example, owners of the datacenters, customers who purchase computational time at the datacenters, or other entities.

The information used by the remote master control system 262 or another component may include data associated with the computational operations to be performed, such as deadlines, priorities (e.g., high vs. low priority tasks), cost to perform based on required computing systems, the optimal computing systems (e.g., CPU vs GPU vs ASIC; processing unit capabilities, speeds, or frequencies, or instructional sets executable by the processing units) for performing each requested computational task, and prices each entity (e.g., company) is willing to pay for computational operations to be performed or otherwise supported via computing systems at a traditional datacenter 260 or a flexible datacenter 220, among others. In addition, the information may also include other data (e.g., weather conditions at locations of datacenters or power sources, any emergencies associated with a datacenter or power source, or the current value of bids associated with an auction for computational tasks).

The information may be updated in-real time and used to make the different operational decisions within the arrangement of FIG. 2. For instance, the information may help a component (e.g., the remote master control system 262 or a control system at a flexible datacenter 220) determine when to ramp up or ramp down power use at a flexible datacenter 220 or when to switch one or more computing systems at a flexible datacenter 220 into a low power mode or to operate at a different frequency, among other operational adjustments. The information can additionally or alternatively help a component within the arrangement of FIG. 2 to determine when to transfer computational operations between computing systems or between datacenters based on various factors. In some instances, the information may also be used to determine when to temporarily stop performing a computational operation or when to perform a computational operation at multiple sites for redundancy or other reasons. The information may further be used to determine when to accept new computational operations from entities or when to temporarily suspend accepting new tasks to be performed due to lack of computing system availability.

The remote master control system 262 represents a computing system that is capable of obtaining, managing, and using the information described above to manage and oversee one or more operations within the arrangement of FIG. 2. As such, the remote master control system 262 may be one or more computing systems configured to process all, or a subset of, the information described above, such as power, environment, computational characterization, and economic factors to assist with the distribution and execution of computing operations among one or more datacenters. For instance, the remote master control system 262 may be configured to obtain and delegate computational operations among one or more datacenters based on a weighted analysis of a variety of factors, including one or more of the cost and availability of power, the types and availability of the computing systems at each datacenter, current and predicted weather conditions at the different locations of flexible datacenters (e.g., flexible datacenters 220) and generation stations (e.g., generation stations 202), levels of power storage available at one or more energy storage systems (e.g., energy storage system 218), and deadlines and other attributes associated with particular computational operations, among other possible factors. As such, the analysis of information performed by the remote master control system 262 may vary within examples. For instance, the remote master control system 262 may use real-time information to determine whether or not to route a computational operation to a particular flexible datacenter (e.g., a flexible datacenter 220) or to transition a computational operation between datacenters (e.g., from traditional datacenter 260 to a flexible datacenter 220).

As shown in FIG. 2, the generation station 202 may be able to supply power to the grid and/or BTM loads such as flexible datacenters 220. With such a configuration, the generation station 202 may selectively provide power to the BTM loads and/or the grid based on economic and power availability considerations. For example, the generation station 202 may supply power to the grid when the price paid for the power exceeds a particular threshold (e.g., the power price offered by operators of the flexible datacenters 220). In some instances, the operator of a flexible datacenter and the operator of a generation station capable of supplying BTM power to the flexible datacenter may utilize a predefined arrangement (e.g., a contract) that specifies a duration and/or price range when the generation station may supply power to the flexible datacenter.

The remote master control system 262 may be capable of directing one or more flexible datacenters 220 to ramp-up or ramp-down to desired power consumption levels, and/or to control cooperative action of multiple flexible datacenters by determining how to power each individual flexible datacenter 220 in accordance with operational directives.

The configuration of the remote master control system 262 can vary within examples as further discussed with respect to FIGS. 2, 3, and 7-9. The remote master control system 262 may operate as a single computing system or may involve a network of computing systems. Preferably, the remote master control system 262 is implemented across one or more servers in a fault-tolerant operating environment that ensures continuous uptime and connectivity by virtue of its distributed nature. Alternatively, although the remote master control system 262 is shown as a physically separate component arrangement for FIG. 2, the remote master control system 262 may be combined with another component in other embodiments. To illustrate an example, the remote master control system 262 may operate as part of a flexible datacenter (e.g., a computing system or a datacenter control system of the flexible datacenter 220), includ-

ing sharing components with a flexible datacenter, sharing power with a flexible datacenter, and/or being co-located with a flexible datacenter.

In addition, the remote master control system **262** may communicate with components within the arrangement of FIG. **2** using various communication technologies, including wired and wireless communication technologies. For instance, the remote master control system **262** may use wired (not illustrated) or wireless communication to communicate with datacenter control systems or other computing systems at the flexible datacenters **220** and the traditional datacenters **260**. The remote master control system **262** may also communicate with entities inside or outside the arrangement of FIG. **2** and other components within the arrangement of FIG. **2** via wired or wireless communication. For instance, the remote master control system **262** may use wireless communication to obtain computational operations from entities seeking support for the computational operations at one or more datacenters in exchange for payment. The remote master control system **262** may communicate directly with the entities or may obtain the computational operations from the traditional datacenters **260**. For instance, an entity may submit jobs (e.g., computational operations) to one or more traditional datacenters **260**. The remote master control system **262** may determine that transferring one or more of the computational operations to a flexible datacenter **220** may better support the transferred computational operations. For example, the remote master control system **262** may determine that the transfer may enable the computational operations to be completed quicker and/or at a lower cost. In some examples, the remote master control system **262** may communicate with the entity to obtain approval prior to transferring the one or more computational operations.

The remote master control system **262** may also communicate with grid operators and/or an operator of generation station **202** to help determine power management strategies when distributing computational operations across the various datacenters. In addition, the remote master control system **262** may communicate with other sources, such as weather prediction systems, historical and current power price databases, and auction systems, etc.

In further examples, the remote master control system **262** or another computing system within the arrangement of FIG. **2** may use wired or wireless communication to submit bids within an auction that involves a bidder (e.g., the highest bid) obtaining computational operations or other tasks to be performed. Particularly, the remote master control system **262** may use the information discussed above to develop bids to obtain computing operations for performance at available computing systems at flexible datacenters (e.g., flexible datacenters **220**).

In the example arrangement shown in FIG. **2**, the flexible datacenters **220** represent example loads that can receive power behind-the-meter from the generation station **202**. In such a configuration, the flexible datacenters **220** may obtain and utilize power behind-the-meter from the generation station **202** to perform various computational operations. Performance of a computational operation may involve one or more computing systems providing resources useful in the computational operation. For instance, the flexible datacenters **220** may include one or more computing systems configured to store information, perform calculations and/or parallel processes, perform simulations, mine cryptocurrencies, and execute applications, among other potential tasks. The computing systems can be specialized or generic and can be arranged at each flexible datacenter **220** in a variety of ways (e.g., straight configuration, zig-zag configuration) as further discussed with respect to FIGS. **6**A, **6**B. Furthermore, although the example arrangement illustrated in FIG. **2** shows configurations where flexible datacenters **220** serve as BTM loads, other types of loads can be used as BTM loads within examples.

The arrangement of FIG. **2** includes the traditional datacenters **260** coupled to metered grid power. The traditional datacenters **260** using metered grid power to provide computational resources to support computational operations. One or more enterprises may assign computational operations to the traditional datacenters **260** with expectations that the datacenters reliably provide resources without interruption (i.e., non-intermittently) to support the computational operations, such as processing abilities, networking, and/or volatile storage. Similarly, one or more enterprises may also request computational operations to be performed by the flexible datacenters **220**. The flexible datacenters **220** differ from the traditional datacenters **260** in that the flexible datacenters **220** are arranged and/or configured to be connected to BTM power, are expected to operate intermittently, and are expected to ramp load (and thus computational capability) up or down regularly in response to control directives. In some examples, the flexible datacenters **220** and the traditional datacenters **260** may have similar configurations and may only differ based on the source(s) of power relied upon to power internal computing systems. Preferably, however, the flexible datacenters **220** include particular fast load ramping abilities (e.g., quickly increase or decrease power usage) and are intended and designed to effectively operate during intermittent periods of time.

FIG. **3** shows a block diagram of the remote master control system **300** according to one or more example embodiments. Remote master control system **262** may take the form of remote master control system **300**, or may include less than all components in remote master control system **300**, different components than in remote master control system **300**, and/or more components than in remote master control system **300**.

The remote master control system **300** may perform one or more operations described herein and may include a processor **302**, a data storage unit **304**, a communication interface **306**, a user interface **308**, an operations and environment analysis module **310**, and a queue system **312**. In other examples, the remote master control system **300** may include more or fewer components in other possible arrangements.

As shown in FIG. **3**, the various components of the remote master control system **300** can be connected via one or more connection mechanisms (e.g., a connection mechanism **314**). In this disclosure, the term "connection mechanism" means a mechanism that facilitates communication between two or more devices, systems, components, or other entities. For instance, a connection mechanism can be a simple mechanism, such as a cable, PCB trace, or system bus, or a relatively complex mechanism, such as a packet-based communication network (e.g., LAN, WAN, and/or the Internet). In some instances, a connection mechanism can include a non-tangible medium (e.g., where the connection is wireless).

As part of the arrangement of FIG. **2**, the remote master control system **300** (corresponding to remote master control system **262**) may perform a variety of operations, such as management and distribution of computational operations among datacenters, monitoring operational, economic, and environment conditions, and power management. For instance, the remote master control system **300** may obtain

computational operations from one or more enterprises for performance at one or more datacenters. The remote master control system **300** may subsequently use information to distribute and assign the computational operations to one or more datacenters (e.g., the flexible datacenters **220**) that have the resources (e.g., particular types of computing systems and available power) available to complete the computational operations. In some examples, the remote master control system **300** may assign all incoming computational operation requests to the queue system **312** and subsequently assign the queued requests to computing systems based on an analysis of current market and power conditions.

Although the remote master control system **300** is shown as a single entity, a network of computing systems may perform the operations of the remote master control system **300** in some examples. For example, the remote master control system **300** may exist in the form of computing systems (e.g., datacenter control systems) distributed across multiple datacenters.

The remote master control system **300** may include one or more processors **302**. As such, the processor **302** may represent one or more general-purpose processors (e.g., a microprocessor) and/or one or more special-purpose processors (e.g., a digital signal processor (DSP)). In some examples, the processor **302** may include a combination of processors within examples. The processor **302** may perform operations, including processing data received from the other components within the arrangement of FIG. **2** and data obtained from external sources, including information such as weather forecasting systems, power market price systems, and other types of sources or databases.

The data storage unit **304** may include one or more volatile, non-volatile, removable, and/or non-removable storage components, such as magnetic, optical, or flash storage, and/or can be integrated in whole or in part with the processor **302**. As such, the data storage unit **304** may take the form of a non-transitory computer-readable storage medium, having stored thereon program instructions (e.g., compiled or non-compiled program logic and/or machine code) that, when executed by the processor **302**, cause the remote master control system **300** to perform one or more acts and/or functions, such as those described in this disclosure. Such program instructions can define and/or be part of a discrete software application. In some instances, the remote master control system **300** can execute program instructions in response to receiving an input, such as from the communication interface **306**, the user interface **308**, or the operations and environment analysis module **310**. The data storage unit **304** may also store other information, such as those types described in this disclosure.

In some examples, the data storage unit **304** may serve as storage for information obtained from one or more external sources. For example, data storage unit **304** may store information obtained from one or more of the traditional datacenters **260**, a generation station **202**, a system associated with the grid, and flexible datacenters **220**. As examples only, data storage **304** may include, in whole or in part, local storage, dedicated server-managed storage, network attached storage, and/or cloud-based storage, and/or combinations thereof.

The communication interface **306** can allow the remote master control system **300** to connect to and/or communicate with another component according to one or more protocols. For instance, the communication interface **306** may be used to obtain information related to current, future, and past prices for power, power availability, current and predicted weather conditions, and information regarding the different datacenters (e.g., current workloads at datacenters, types of computing systems available within datacenters, price to obtain power at each datacenter, levels of power storage available and accessible at each datacenter, etc.). In an example, the communication interface **306** can include a wired interface, such as an Ethernet interface or a high-definition serial-digital-interface (HD-SDI). In another example, the communication interface **406** can include a wireless interface, such as a cellular, satellite, WiMAX, or WI-FI interface. A connection can be a direct connection or an indirect connection, the latter being a connection that passes through and/or traverses one or more components, such as such as a router, switcher, or other network device. Likewise, a wireless transmission can be a direct transmission or an indirect transmission. The communication interface **306** may also utilize other types of wireless communication to enable communication with datacenters positioned at various locations.

The communication interface **306** may enable the remote master control system **300** to communicate with the components of the arrangement of FIG. **2**. In addition, the communication interface **306** may also be used to communicate with the various datacenters, power sources, and different enterprises submitting computational operations for the datacenters to support.

The user interface **308** can facilitate interaction between the remote master control system **300** and an administrator or user, if applicable. As such, the user interface **308** can include input components such as a keyboard, a keypad, a mouse, a touch-sensitive panel, a microphone, and/or a camera, and/or output components such as a display device (which, for example, can be combined with a touch-sensitive panel), a sound speaker, and/or a haptic feedback system. More generally, the user interface **308** can include hardware and/or software components that facilitate interaction between remote master control system **300** and the user of the system.

In some examples, the user interface **308** may enable the manual examination and/or manipulation of components within the arrangement of FIG. **2**. For instance, an administrator or user may use the user interface **308** to check the status of, or change, one or more computational operations, the performance or power consumption at one or more datacenters, the number of tasks remaining within the queue system **312**, and other operations. As such, the user interface **308** may provide remote connectivity to one or more systems within the arrangement of FIG. **2**.

The operations and environment analysis module **310** represents a component of the remote master control system **300** associated with obtaining and analyzing information to develop instructions/directives for components within the arrangement of FIG. **2**. The information analyzed by the operations and environment analysis module **310** can vary within examples and may include the information described above with respect predicting and/or directing the use of BTM power. For instance, the operations and environment analysis module **310** may obtain and access information related to the current power state of computing systems operating as part of the flexible datacenters **220** and other datacenters that the remote master control system **300** has access to. This information may be used to determine when to adjust power usage or mode of one or more computing systems. In addition, the remote master control system **300** may provide instructions a flexible datacenter **220** to cause a subset of the computing systems to transition into a low power mode to consume less power while still performing

operations at a slower rate. The remote master control system **300** may also use power state information to cause a set of computing systems at a flexible datacenter **220** to operate at a higher power consumption mode. In addition, the remote master control system **300** may transition computing systems into sleep states or power on/off based on information analyzed by the operations and environment analysis module **310**.

In some examples, the operations and environment analysis module **310** may use location, weather, activity levels at the flexible datacenters or the generation station, and power cost information to determine control strategies for one or more components in the arrangement of FIG. **2**. For instance, the remote master control system **300** may use location information for one or more datacenters to anticipate potential weather conditions that could impact access to power. In addition, the operations and environment analysis module **310** may assist the remote master control system **300** determine whether to transfer computational operations between datacenters based on various economic and power factors.

The queue system **312** represents a queue capable of organizing computational operations to be performed by one or more datacenters. Upon receiving a request to perform a computational operation, the remote master control system **300** may assign the computational operation to the queue until one or more computing systems are available to support the computational operation. The queue system **312** may be used for organizing and transferring computational tasks in real time.

The organizational design of the queue system **312** may vary within examples. In some examples, the queue system **312** may organize indications (e.g., tags, pointers) to sets of computational operations requested by various enterprises. The queue system **312** may operate as a First-In-First-Out (FIFO) data structure. In a FIFO data structure, the first element added to the queue will be the first one to be removed. As such, the queue system **312** may include one or more queues that operate using the FIFO data structure.

In some examples, one or more queues within the queue system **312** may use other designs of queues, including rules to rank or organize queues in a particular manner that can prioritize some sets of computational operations over others. The rules may include one or more of an estimated cost and/or revenue to perform each set of computational operations, an importance assigned to each set of computational operations, and deadlines for initiating or completing each set of computational operations, among others. Examples using a queue system are further described below with respect to FIG. **9**.

In some examples, the remote master control system **300** may be configured to monitor one or more auctions to obtain computational operations for datacenters to support. Particularly, the remote master control system **300** may use resource availability and power prices to develop and submit bids to an external or internal auction system for the right to support particular computational operations. As a result, the remote master control system **300** may identify computational operations that could be supported at one or more flexible datacenters **220** at low costs.

FIG. **4** is a block diagram of a generation station **400**, according to one or more example embodiments. Generation station **202** may take the form of generation station **400**, or may include less than all components in generation station **400**, different components than in generation station **400**, and/or more components than in generation station **400**. The generation station **400** includes power generation equipment **401**, a communication interface **408**, a behind-the-meter interface **406**, a grid interface **404**, a user interface **410**, a generation station control system **414**, and power transformation equipment **402**. The power generation equipment **210** may take the form of power generation equipment **401**, or may include less than all components in power generation equipment **401**, different components than in power generation equipment **401**, and/or more components than in power generation equipment **401**. Generation station control system **216** may take the form of generation station control system **414**, or may include less than all components in generation station control system **414**, different components than in generation station control system **414**, and/or more components than in generation station control system **414**. Some or all of the components generation station **400** may be connected via a communication interface **516**. These components are illustrated in FIG. **4** to convey an example configuration for the generation station **400** (corresponding to generation station **202** shown in FIG. **2**). In other examples, the generation station **400** may include more or fewer components in other arrangements.

The generation station **400** can correspond to any type of grid-connected utility-scale power producer capable of supplying power to one or more loads. The size, amount of power generated, and other characteristics of the generation station **400** may differ within examples. For instance, the generation station **400** may be a power producer that provides power intermittently. The power generation may depend on monitored power conditions, such as weather at the location of the generation station **400** and other possible conditions. As such, the generation station **400** may be a temporary arrangement, or a permanent facility, configured to supply power. The generation station **400** may supply BTM power to one or more loads and supply metered power to the electrical grid. Particularly, the generation station **400** may supply power to the grid as shown in the arrangement of FIG. **2**.

The power generation equipment **401** represents the component or components configured to generate utility-scale power. As such, the power generation equipment **401** may depend on the type of facility that the generation station **400** corresponds to. For instance, the power generation equipment **401** may correspond to electric generators that transform kinetic energy into electricity. The power generation equipment **401** may use electromagnetic induction to generate power. In other examples, the power generation equipment **401** may utilize electrochemistry to transform chemical energy into power. The power generation equipment **401** may use the photovoltaic effect to transform light into electrical energy. In some examples, the power generation equipment **401** may use turbines to generate power. The turbines may be driven by, for example, wind, water, steam or burning gas. Other examples of power production are possible.

The communication interface **408** can enable the generation station **400** to communicate with other components within the arrangement of FIG. **2**. As such, the communication interface **408** may operate similarly to the communication interface **306** of the remote master control system **300** and the communication interface **503** of the flexible datacenter **500**.

The generation station control system **414** may be one or more computing systems configured to control various aspects of the generation station **400**.

The BTM interface **406** is a module configured to enable the power generation equipment **401** to supply BTM power to one or more loads and may include multiple components.

The arrangement of the BTM interface **406** may differ within examples based on various factors, such as the number of flexible datacenters **220** (or **500**) coupled to the generation station **400**, the proximity of the flexible datacenters **220** (or **500**), and the type of generation station **400**, among others. In some examples, the BTM interface **406** may be configured to enable power delivery to one or more flexible datacenters positioned near the generation station **400**. Alternatively, the BTM interface **406** may also be configured to enable power delivery to one or more flexible datacenters **220** (or **500**) positioned remotely from the generation station **400**.

The grid interface **404** is a module configured to enable the power generation equipment **401** to supply power to the grid and may include multiple components. As such, the grid interface **404** may couple to one or more transmission lines (e.g., transmission lines **404***a* shown in FIG. **2**) to enable delivery of power to the grid.

The user interface **410** represents an interface that enables administrators and/or other entities to communicate with the generation station **400**. As such, the user interface **410** may have a configuration that resembles the configuration of the user interface **308** shown in FIG. **3**. An operator may utilize the user interface **410** to control or monitor operations at the generation station **400**.

The power transformation equipment **402** represents equipment that can be utilized to enable power delivery from the power generation equipment **401** to the loads and to transmission lines linked to the grid. Example power transformation equipment **402** includes, but is not limited to, transformers, inverters, phase converters, and power conditioners.

FIG. **5** shows a block diagram of a flexible datacenter **500**, according to one or more example embodiments. Flexible datacenters **220** may take the form of flexible datacenter **500**, or may include less than all components in flexible datacenter **500**, different components than in flexible datacenter **500**, and/or more components than in flexible datacenter **500**. In the example embodiment shown in FIG. **5**, the flexible datacenter **500** includes a power input system **502**, a communication interface **503**, a datacenter control system **504**, a power distribution system **506**, a climate control system **508**, one or more sets of computing systems **512**, and a queue system **514**. These components are shown connected by a communication bus **528**. In other embodiments, the configuration of flexible datacenter **500** can differ, including more or fewer components. In addition, the components within flexible datacenter **500** may be combined or further divided into additional components within other embodiments.

The example configuration shown in FIG. **5** represents one possible configuration for a flexible datacenter. As such, each flexible datacenter may have a different configuration when implemented based on a variety of factors that may influence its design, such as location and temperature that the location, particular uses for the flexible datacenter, source of power supplying computing systems within the flexible datacenter, design influence from an entity (or entities) that implements the flexible datacenter, and space available for the flexible datacenter. Thus, the embodiment of flexible datacenter **220** shown in FIG. **2** represents one possible configuration for a flexible datacenter out of many other possible configurations.

The flexible datacenter **500** may include a design that allows for temporary and/or rapid deployment, setup, and start time for supporting computational operations. For instance, the flexible datacenter **500** may be rapidly deployed at a location near a source of generation station power (e.g., near a wind farm or solar farm). Rapid deployment may involve positioning the flexible datacenter **500** at a target location and installing and/or configuring one or more racks of computing systems within. The racks may include wheels to enable swift movement of the computing systems. Although the flexible datacenter **500** could theoretically be placed anywhere, transmission losses may be minimized by locating it proximate to BTM power generation.

The physical construction and layout of the flexible datacenter **500** can vary. In some instances, the flexible datacenter **500** may utilize a metal container (e.g., a metal container **602** shown in FIG. **6**A). In general, the flexible datacenter **500** may utilize some form of secure weatherproof housing designed to protect interior components from wind, weather, and intrusion. The physical construction and layout of example flexible datacenters are further described with respect to FIGS. **6**A-**6**B.

Within the flexible datacenter **500**, various internal components enable the flexible datacenter **500** to utilize power to perform some form of operations. The power input system **502** is a module of the flexible datacenter **500** configured to receive external power and input the power to the different components via assistance from the power distribution system **506**. As discussed with respect to FIG. **2**, the sources of external power feeding a flexible datacenter can vary in both quantity and type (e.g., the generation stations **202**, **400**, grid-power, energy storage systems). Power input system **502** includes a BTM power input sub-system **522**, and may additionally include other power input sub-systems (e.g., a grid-power input sub-system **524** and/or an energy storage input sub-system **526**). In some instances, the quantity of power input sub-systems may depend on the size of the flexible datacenter and the number and/or type of computing systems being powered. In an example embodiment, the flexible datacenter may use grid power as the primary power supply.

In some embodiments, the power input system **502** may include some or all of flexible datacenter Power Equipment **220**B. The power input system **502** may be designed to obtain power in different forms (e.g., single phase or three-phase behind-the-meter alternating current ("AC") voltage, and/or direct current ("DC") voltage). As shown, the power input system **502** includes a BTM power input sub-system **522**, a grid power input sub-system **524**, and an energy input sub-system **526**. These sub-systems are included to illustrate example power input sub-systems that the flexible datacenter **500** may utilize, but other examples are possible. In addition, in some instances, these sub-systems may be used simultaneously to supply power to components of the flexible datacenter **500**. The sub-systems may also be used based on available power sources.

In some implementations, the BTM power input sub-system **522** may include one or more AC-to-AC step-down transformers used to step down supplied medium-voltage AC to low voltage AC (e.g., 120V to 600V nominal) used to power computing systems **512** and/or other components of flexible datacenter **500**. The power input system **502** may also directly receive single-phase low voltage AC from a generation station as BTM power, from grid power, or from a stored energy system such as energy storage system **218**. In some implementations, the power input system **502** may provide single-phase AC voltage to the datacenter control system **504** (and/or other components of flexible datacenter **500**) independent of power supplied to computing systems **512** to enable the datacenter control system **504** to perform

management operations for the flexible datacenter **500**. For instance, the grid power input sub-system **524** may use grid power to supply power to the datacenter control system **504** to ensure that the datacenter control system **504** can perform control operations and communicate with the remote master control system **300** (or **262**) during situations when BTM power is not available. As such, the datacenter control system **504** may utilize power received from the power input system **502** to remain powered to control the operation of flexible datacenter **500**, even if the computational operations performed by the computing system **512** are powered intermittently. In some instances, the datacenter control system **504** may switch into a lower power mode to utilize less power while still maintaining the ability to perform some functions.

The power distribution system **506** may distribute incoming power to the various components of the flexible datacenter **500**. For instance, the power distribution system **506** may direct power (e.g., single-phase or three-phase AC) to one or more components within flexible datacenter **500**. In some embodiments, the power distribution system **506** may include some or all of flexible datacenter Power Equipment **220**B.

In some examples, the power input system **502** may provide three phases of three-phase AC voltage to the power distribution system **506**. The power distribution system **506** may controllably provide a single phase of AC voltage to each computing system or groups of computing systems **512** disposed within the flexible datacenter **500**. The datacenter control system **504** may controllably select which phase of three-phase nominal AC voltage that power distribution system **506** provides to each computing system **512** or groups of computing systems **512**. This is one example manner in which the datacenter control system **504** may modulate power delivery (and load at the flexible datacenter **500**) by ramping-up flexible datacenter **500** to fully operational status, ramping-down flexible datacenter **500** to offline status (where only datacenter control system **504** remains powered), reducing load by withdrawing power delivery from, or reducing power to, one or more of the computing systems **512** or groups of the computing systems **512**, or modulating power factor correction for the generation station **300** (or **202**) by controllably adjusting which phases of three-phase nominal AC voltage are used by one or more of the computing systems **512** or groups of the computing systems **512**. The datacenter control system **504** may direct power to certain sets of computing systems based on computational operations waiting for computational resources within the queue system **514**. In some embodiments, the flexible datacenter **500** may receive BTM DC power to power the computing systems **512**.

One of ordinary skill in the art will recognize that a voltage level of three-phase AC voltage may vary based on an application or design and the type or kind of local power generation. As such, a type, kind, or configuration of the operational AC-to-AC step down transformer (not shown) may vary based on the application or design. In addition, the frequency and voltage level of three-phase AC voltage, single-phase AC voltage, and DC voltage may vary based on the application or design in accordance with one or more embodiments.

As discussed above, the datacenter control system **504** may perform operations described herein, such as dynamically modulating power delivery to one or more of the computing systems **512** disposed within flexible datacenter **500**. For instance, the datacenter control system **504** may modulate power delivery to one or more of the computing systems **512** based on various factors, such as BTM power availability or an operational directive from a generation station **262** or **300** control system, a remote master control system **262** or **300**, or a grid operator. In some examples, the datacenter control system **504** may provide computational operations to sets of computing systems **512** and modulate power delivery based on priorities assigned to the computational operations. For instance, an important computational operation (e.g., based on a deadline for execution and/or price paid by an entity) may be assigned to a particular computing system or set of computing systems **512** that has the capacity, computational abilities to support the computational operation. In addition, the datacenter control system **504** may also prioritize power delivery to the computing system or set of computing systems **512**.

In some example, the datacenter control system **504** may further provide directives to one or more computing systems to change operations in some manner. For instance, the datacenter control system **504** may cause one or more computing systems **512** to operate at a lower or higher frequency, change clock cycles, or operate in a different power consumption mode (e.g., a low power mode). These abilities may vary depending on types of computing systems **512** available at the flexible datacenter **500**. As a result, the datacenter control system **504** may be configured to analyze the computing systems **512** available either on a periodic basis (e.g., during initial set up of the flexible datacenter **500**) or in another manner (e.g., when a new computational operation is assigned to the flexible datacenter **500**).

The datacenter control system **504** may also implement directives received from the remote master control system **262** or **300**. For instance, the remote master control system **262** or **300** may direct the flexible datacenter **500** to switch into a low power mode. As a result, one or more of the computing systems **512** and other components may switch to the low power mode in response.

The datacenter control system **504** may utilize the communication interface **503** to communicate with the remote master control system **262** or **300**, other datacenter control systems of other datacenters, and other entities. As such, the communication interface **503** may include components and operate similar to the communication interface **306** of the remote master control system **300** described with respect to FIG. **4**.

The flexible datacenter **500** may also include a climate control system **508** to maintain computing systems **512** within a desired operational temperature range. The climate control system **508** may include various components, such as one or more air intake components, an evaporative cooling system, one or more fans, an immersive cooling system, an air conditioning or refrigerant cooling system, and one or more air outtake components. One of ordinary skill in the art will recognize that any suitable heat extraction system configured to maintain the operation of computing systems **512** within the desired operational temperature range may be used.

The flexible datacenter **500** may further include an energy storage system **510**. The energy storage system **510** may store energy for subsequent use by computing systems **512** and other components of flexible datacenter **500**. For instance, the energy storage system **510** may include a battery system. The battery system may be configured to convert AC voltage to DC voltage and store power in one or more storage cells. In some instances, the battery system may include a DC-to-AC inverter configured to convert DC

voltage to AC voltage, and may further include an AC phase-converter, to provide AC voltage for use by flexible datacenter **500**.

The energy storage system **510** may be configured to serve as a backup source of power for the flexible datacenter **500**. For instance, the energy storage system **510** may receive and retain power from a BTM power source at a low cost (or no cost at all). This low-cost power can then be used by the flexible datacenter **500** at a subsequent point, such as when BTM power costs more. Similarly, the energy storage system **510** may also store energy from other sources (e.g., grid power). As such, the energy storage system **510** may be configured to use one or more of the sub-systems of the power input system **502**.

In some examples, the energy storage system **510** may be external to the flexible datacenter **500**. For instance, the energy storage system **510** may be an external source that multiple flexible datacenters utilize for back-up power.

The computing systems **512** represent various types of computing systems configured to perform computational operations. Performance of computational operations include a variety of tasks that one or more computing systems may perform, such as data storage, calculations, application processing, parallel processing, data manipulation, cryptocurrency mining, and maintenance of a distributed ledger, among others. As shown in FIG. **5**, the computing systems **512** may include one or more CPUs **516**, one or more GPUs **518**, and/or one or more Application-Specific Integrated Circuits (ASIC's) **520**. Each type of computing system **512** may be configured to perform particular operations or types of operations.

Due to different performance features and abilities associated with the different types of computing systems, the datacenter control system **504** may determine, maintain, and/or relay this information about the types and/or abilities of the computing systems, quantity of each type, and availability to the remote master control system **262** or **300** on a routine basis (e.g., periodically or on-demand). This way, the remote master control system **262** or **300** may have current information about the abilities of the computing systems **512** when distributing computational operations for performance at one or more flexible datacenters. Particularly, the remote master control system **262** or **300** may assign computational operations based on various factors, such as the types of computing systems available and the type of computing systems required by each computing operation, the availability of the computing systems, whether computing systems can operate in a low power mode, and/or power consumption and/or costs associated with operating the computing systems, among others.

The quantity and arrangement of these computing systems **512** may vary within examples. In some examples, the configuration and quantity of computing systems **512** may depend on various factors, such as the computational tasks that are performed by the flexible datacenter **500**. In other examples, the computing systems **512** may include other types of computing systems as well, such as DSPs, SIMDs, neural processors, and/or quantum processors.

As indicated above, the computing systems **512** can perform various computational operations, including in different configurations. For instance, each computing system may perform a particular computational operation unrelated to the operations performed at other computing systems. Groups of the computing systems **512** may also be used to work together to perform computational operations.

In some examples, multiple computing systems may perform the same computational operation in a redundant configuration. This redundant configuration creates a back-up that prevents losing progress on the computational operation in situations of a computing failure or intermittent operation of one or more computing systems. In addition, the computing systems **512** may also perform computational operations using a check point system. The check point system may enable a first computing system to perform operations up to a certain point (e.g., a checkpoint) and switch to a second computing system to continue performing the operations from that certain point. The check point system may also enable the datacenter control system **504** to communicate statuses of computational operations to the remote master control system **262** or **300**. This can further enable the remote master control system **262 300** to transfer computational operations between different flexible datacenters allowing computing systems at the different flexible datacenters to resume support of computational operations based on the check points.

The queue system **514** may operate similar to the queue system **312** of the remote master control system **300** shown in FIG. **3**. Particularly, the queue system **514** may help store and organize computational tasks assigned for performance at the flexible datacenter **500**. In some examples, the queue system **514** may be part of a distributed queue system such that each flexible datacenter in a fleet of flexible datacenter includes a queue, and each queue system **514** may be able to communicate with other queue systems. In addition, the remote master control system **262** or **300** may be configured to assign computational tasks to the queues located at each flexible datacenter (e.g., the queue system **514** of the flexible datacenter **500**). As such, communication between the remote master control system **262** or **300** and the datacenter control system **504** and/or the queue system **514** may allow organization of computational operations for the flexible datacenter **500** to support.

FIG. **6**A shows another structural arrangement for a flexible datacenter, according to one or more example embodiments. The particular structural arrangement shown in FIG. **6**A may be implemented at flexible datacenter **500**. The illustration depicts the flexible datacenter **500** as a mobile container **702** equipped with the power input system **502**, the power distribution system **506**, the climate control system **508**, the datacenter control system **504**, and the computing systems **512** arranged on one or more racks **604**. These components of flexible datacenter **500** may be arranged and organized according to an example structural region arrangement. As such, the example illustration represents one possible configuration for the flexible datacenter **500**, but others are possible within examples.

As discussed above, the structural arrangement of the flexible datacenter **500** may depend on various factors, such as the ability to maintain temperature within the mobile container **602** within a desired temperature range. The desired temperature range may depend on the geographical location of the mobile container **602** and the type and quantity of the computing systems **512** operating within the flexible datacenter **500** as well as other possible factors. As such, the different design elements of the mobile container **602** including the inner contents and positioning of components may depend on factors that aim to maximize the use of space within mobile container **602**, lower the amount of power required to cool the computing systems **512**, and make setup of the flexible datacenter **500** efficient. For instance, a first flexible datacenter positioned in a cooler geographic region may include less cooling equipment than a second flexible datacenter positioned in a warmer geographic region.

As shown in FIG. **6**A, the mobile container **602** may be a storage trailer disposed on permanent or removable wheels and configured for rapid deployment. In other embodiments, the mobile container **602** may be a storage container (not shown) configured for placement on the ground and potentially stacked in a vertical or horizontal manner (not shown). In still other embodiments, the mobile container **602** may be an inflatable container, a floating container, or any other type or kind of container suitable for housing a mobile flexible datacenter. As such, the flexible datacenter **500** may be rapidly deployed on site near a source of unutilized behind-the-meter power generation. And in still other embodiments, the flexible datacenter **500** might not include a mobile container. For example, the flexible datacenter **500** may be situated within a building or another type of stationary environment.

FIG. **6**B shows the computing systems **512** in a straight-line configuration for installation within the flexible datacenter **500**, according to one or more example embodiments. As indicated above, the flexible datacenter **500** may include a plurality of racks **604**, each of which may include one or more computing systems **512** disposed therein. As discussed above, the power input system **502** may provide three phases of AC voltage to the power distribution system **506**. In some examples, the power distribution system **506** may controllably provide a single phase of AC voltage to each computing system **512** or group of computing systems **512** disposed within the flexible datacenter **500**. As shown in FIG. **6**B, for purposes of illustration only, eighteen total racks **604** are divided into a first group of six racks **606**, a second group of six racks **608**, and a third group of six racks **610**, where each rack contains eighteen computing systems **512**. The power distribution system (**506** of FIG. **5**) may, for example, provide a first phase of three-phase AC voltage to the first group of six racks **606**, a second phase of three-phase AC voltage to the second group of six racks **608**, and a third phase of three-phase AC voltage to the third group of six racks **610**. In other embodiments, the quantity of racks and computing systems can vary.

FIG. **7** shows a control distribution system **700** of the flexible datacenter **500** according to one or more example embodiments. The system **700** includes a grid operator **702**, a generation station control system **216**, a remote master control system **300**, and a flexible datacenter **500**. As such, the system **700** represents one example configuration for controlling operations of the flexible datacenter **500**, but other configurations may include more or fewer components in other arrangements.

The datacenter control system **504** may independently or cooperatively with one or more of the generation station control system **414**, the remote master control system **300**, and/or the grid operator **702** modulate power at the flexible datacenter **500**. During operations, the power delivery to the flexible datacenter **500** may be dynamically adjusted based on conditions or operational directives. The conditions may correspond to economic conditions (e.g., cost for power, aspects of computational operations to be performed), power-related conditions (e.g., availability of the power, the sources offering power), demand response, and/or weather-related conditions, among others.

The generation station control system **414** may be one or more computing systems configured to control various aspects of a generation station (not independently illustrated, e.g., **216** or **400**). As such, the generation station control system **414** may communicate with the remote master control system **300** over a networked connection **706** and with the datacenter control system **704** over a networked or other data connection **708**.

As discussed with respect to FIGS. **2** and **3**, the remote master control system **300** can be one or more computing systems located offsite, but connected via a network connection **710** to the datacenter control system **504**. The remote master control system **300** may provide supervisory controls or override control of the flexible datacenter **500** or a fleet of flexible datacenters (not shown).

The grid operator **702** may be one or more computing systems that are configured to control various aspects of the power grid (not independently illustrated) that receives power from the generation station. The grid operator **702** may communicate with the generation station control system **300** over a networked or other data connection **712**.

The datacenter control system **504** may monitor BTM power conditions at the generation station and determine when a datacenter ramp-up condition is met. The BTM power availability may include one or more of excess local power generation, excess local power generation that the grid cannot accept, local power generation that is subject to economic curtailment, local power generation that is subject to reliability curtailment, local power generation that is subject to power factor correction, conditions where the cost for power is economically viable (e.g., low cost to obtain power), low priced power, situations where local power generation is prohibitively low, start up situations, transient situations, or testing situations where there is an economic advantage to using locally generated behind-the-meter power generation, specifically power available at little to no cost and with no associated transmission or distribution losses or costs. For example, a datacenter control system may analyze future workload and near term weather conditions at the flexible datacenter.

In some instances, the datacenter ramp-up condition may be met if there is sufficient behind-the-meter power availability and there is no operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702** to go offline or reduce power. As such, the datacenter control system **504** may enable 714 the power input system **502** to provide power to the power distribution system **506** to power the computing systems **512** or a subset thereof.

The datacenter control system **504** may optionally direct one or more computing systems **512** to perform predetermined computational operations (e.g., distributed computing processes). For example, if the one or more computing systems **512** are configured to perform blockchain hashing operations, the datacenter control system **504** may direct them to perform blockchain hashing operations for a specific blockchain application, such as, for example, Bitcoin, Litecoin, or Ethereum. Alternatively, one or more computing systems **512** may be configured to perform high-throughput computing operations and/or high performance computing operations.

The remote master control system **300** may specify to the datacenter control system **504** what sufficient behind-the-meter power availability constitutes, or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently. For example, in certain circumstances, sufficient behind-the-meter power availability may be less than that required to fully power the entire flexible datacenter **500**. In such circumstances, the datacenter control system **504** may provide power to only a subset of computing systems, or operate the plurality of computing systems in a

lower power mode, that is within the sufficient, but less than full, range of power that is available. In addition, the computing systems **512** may adjust operational frequency, such as performing more or less processes during a given duration. The computing systems **512** may also adjust internal clocks via over-clocking or under-clocking when performing operations.

While the flexible datacenter **500** is online and operational, a datacenter ramp-down condition may be met when there is insufficient or anticipated to be insufficient, behind-the-meter power availability or there is an operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. The datacenter control system **504** may monitor and determine when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability. As noted above, sufficiency may be specified by the remote master control system **300** or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently.

An operational directive may be based on current dispatch-ability, forward looking forecasts for when behind-the-meter power is, or is expected to be, available, economic considerations, reliability considerations, operational considerations, or the discretion of the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. For example, the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may issue an operational directive to flexible datacenter **500** to go offline and power down. When the datacenter ramp-down condition is met, the datacenter control system **504** may disable power delivery to the plurality of computing systems (e.g., **512**). The datacenter control system **504** may disable **714** the power input system **502** from providing power (e.g., three-phase nominal AC voltage) to the power distribution system **506** to power down the computing systems **512** while the datacenter control system **504** remains powered and is capable of returning service to operating mode at the flexible datacenter **500** when behind-the-meter power becomes available again.

While the flexible datacenter **500** is online and operational, changed conditions or an operational directive may cause the datacenter control system **504** to modulate power consumption by the flexible datacenter **500**. The datacenter control system **504** may determine, or the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in less power generation, availability, or economic feasibility, than would be necessary to fully power the flexible datacenter **500**. In such situations, the datacenter control system **504** may take steps to reduce or stop power consumption by the flexible datacenter **500** (other than that required to maintain operation of datacenter control system **504**).

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to reduce power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically reduce or withdraw power delivery to one or more computing systems **512** to meet the dictate. The datacenter control system **504** may controllably provide three-phase nominal AC voltage to a smaller subset of computing systems (e.g., **512**) to reduce power consumption. The datacenter control system **504** may dynamically reduce the power consumption of one or more computing systems by reducing their operating frequency or forcing them into a lower power mode through a network directive.

Similarly, the flexible datacenter **500** may ramp up power consumption based on various conditions. For instance, the datacenter control system **504** may determine, or the generation control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in greater power generation, availability, or economic feasibility. In such situations, the datacenter control system **504** may take steps to increase power consumption by the flexible datacenter **500**.

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to increase power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically increase power delivery to one or more computing systems **512** (or operations at the computing systems **512**) to meet the dictate. For instance, one or more computing systems **512** may transition into a higher power mode, which may involve increasing power consumption and/or operation frequency.

One of ordinary skill in the art will recognize that datacenter control system **504** may be configured to have a number of different configurations, such as a number or type or kind of the computing systems **512** that may be powered, and in what operating mode, that correspond to a number of different ranges of sufficient and available behind-the-meter power. As such, the datacenter control system **504** may modulate power delivery over a variety of ranges of sufficient and available unutilized behind-the-meter power availability.

FIG. **8** shows a control distribution system **800** of a fleet of flexible datacenters according to one or more example embodiments. The control distribution system **800** of the flexible datacenter **500** shown and described with respect to FIG. **7** may be extended to a fleet of flexible datacenters as illustrated in FIG. **8**. For example, a first generation station (not independently illustrated), such as a wind farm, may include a first plurality of flexible datacenters **802**, which may be collocated or distributed across the generation station. A second generation station (not independently illustrated), such as another wind farm or a solar farm, may include a second plurality of flexible datacenters **804**, which may be collocated or distributed across the generation station. One of ordinary skill in the art will recognize that the number of flexible datacenters deployed at a given station and the number of stations within the fleet may vary based on an application or design in accordance with one or more example embodiments.

The remote master control system **300** may provide directive to datacenter control systems of the fleet of flexible datacenters in a similar manner to that shown and described with respect to FIG. **7**, with the added flexibility to make high level decisions with respect to fleet that may be counterintuitive to a given station. The remote master control system **300** may make decisions regarding the issuance of operational directives to a given generation station based on, for example, the status of each generation station where flexible datacenters are deployed, the workload distributed across fleet, and the expected computational demand required for one or both of the expected workload and predicted power availability. In addition, the remote master control system **300** may shift workloads from the first plurality of flexible datacenters **802** to the second plurality of flexible datacenters **804** for any reason, including, for

example, a loss of BTM power availability at one generation station and the availability of BTM power at another generation station. As such, the remote master control system **300** may communicate with the generation station control systems **806**A, **806**B to obtain information that can be used to organize and distribute computational operations to the fleets of flexible datacenters **802**, **804**.

FIG. **9** shows a queue distribution arrangement for a traditional datacenter **902** and a flexible datacenter **500**, according to one or more example embodiments. The arrangement of FIG. **9** includes a flexible datacenter **500**, a traditional datacenter **902**, a queue system **312**, a set of communication links **916**, **918**, **920**A, **920**B, and the remote master control system **300**. The arrangement of FIG. **9** represents an example configuration scheme that can be used to distribute computing operations using a queue system **312** between the traditional datacenter **902** and one or more flexible datacenters. In other examples, the arrangement of FIG. **9** may include more or fewer components in other potential configurations. For instance, the arrangement of FIG. **9** may not include the queue system **312** or may include routes that bypass the queue system **312**.

The arrangement of FIG. **9** may enable computational operations requested to be performed by entities (e.g., companies). As such, the arrangement of FIG. **9** may use the queue system **312** to organize incoming computational operations requests to enable efficient distribution to the flexible datacenter **500** and the critical traditional datacenter **902**. Particularly, the arrangement of FIG. **9** may use the queue system **312** to organize sets of computational operations thereby increasing the speed of distribution and performance of the different computational operations among datacenters. As a result, the use of the queue system **312** may reduce time to complete operations and reduce costs.

In some examples, one or more components, such as the datacenter control system **504**, the remote master control system **300**, the queue system **312**, or the control system **936**, may be configured to identify situations that may arise where using the flexible datacenter **500** can reduce costs or increase productivity of the system, as compared to using the traditional datacenter **902** for computational operations. For example, a component within the arrangement of FIG. **9** may identify when using behind-the-meter power to power the computing systems **512** within the flexible datacenter **500** is at a lower cost compared to using the computing systems **934** within the traditional datacenter **902** that are powered by grid power. Additionally, a component in the arrangement of FIG. **9** may be configured to determine situations when offloading computational operations from the traditional datacenter **902** indirectly (i.e., via the queue system **312**) or directly (i.e., bypassing the queue system **312**) to the flexible datacenter **500** can increase the performance allotted to the computational operations requested by an entity (e.g., reduce the time required to complete time-sensitive computational operations).

In some examples, the datacenter control system **504** may monitor activity of the computing systems **512** within the flexible datacenter **500** and use the respective activity levels to determine when to obtain computational operations from the queue system **312**. For instance, the datacenter control system **504** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **512** to perform. The various factors may include power availability at the flexible datacenter **500** (e.g., either stored or from a BTM source), availability of the computing systems **512** (e.g., percentage of computing systems available), type of computational operations available, estimated cost to perform the computational operations at the flexible datacenter **500**, cost for power, cost for power relative to cost for grid power, and instructions from other components within the system, among others. The datacenter control system **504** may analyze one or more of the factors when determining whether to obtain a new set of computational operations for the computing systems **512** to perform. In such a configuration, the datacenter control system **504** manages the activity of the flexible datacenter **500**, including determining when to acquire new sets of computational operations when capacity among the computing systems **512** permit.

In other examples, a component (e.g., the remote master control system **300**) within the system may assign or distribute one or more sets of computational operations organized by the queue system **312** to the flexible datacenter **500**. For example, the remote master control system **300** may manage the queue system **312**, including the distribution of computational operations organized by the queue system **312** to the flexible datacenter **500** and the traditional datacenter **902**. The remote master control system **300** may utilize to information described with respect to the Figures above to determine when to assign computational operations to the flexible datacenter **500**.

The traditional datacenter **902** may include a power input system **930**, a power distribution system **932**, a datacenter control system **936**, and a set of computing systems **934**. The power input system **930** may be configured to receive power from a power grid and distribute the power to the computing systems **934** via the power distribution system **932**. The datacenter control system **936** may monitor activity of the computing systems **934** and obtain computational operations to perform from the queue system **312**. The datacenter control system **936** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **934** to perform. A component (e.g., the remote master control system **300**) within the arrangement of FIG. **9** may assign or distribute one or more sets of computational operations organized by the queue system **312** to the traditional datacenter **902**.

The communication link **916** represents one or more links that may serve to connect the flexible datacenter **500**, the traditional datacenter **902**, and other components within the system (e.g., the remote master control system **300**, the queue system **312**—connections not shown). In particular, the communication link **916** may enable direct or indirect communication between the flexible datacenter **500** and the traditional datacenter **902**. The type of communication link **916** may depend on the locations of the flexible datacenter **500** and the traditional datacenter **902**. Within embodiments, different types of communication links can be used, including but not limited to WAN connectivity, cloud-based connectivity, and wired and wireless communication links.

The queue system **312** represents an abstract data type capable of organizing computational operation requests received from entities. As each request for computational operations are received, the queue system **312** may organize the request in some manner for subsequent distribution to a datacenter. Different types of queues can make up the queue system **312** within embodiments. The queue system **312** may be a centralized queue that organizes all requests for computational operations. As a centralized queue, all incoming requests for computational operations may be organized by the centralized queue.

In other examples, the queue system **312** may be distributed consisting of multiple queue sub-systems. In the distributed configuration, the queue system **312** may use multiple queue sub-systems to organize different sets of computational operations. Each queue sub-system may be used to organize computational operations based on various factors, such as according to deadlines for completing each set of computational operations, locations of enterprises submitting the computational operations, economic value associated with the completion of computational operations, and quantity of computing resources required for performing each set of computational operations. For instance, a first queue sub-system may organize sets of non-intensive computational operations and a second queue sub-system may organize sets of intensive computational operations. In some examples, the queue system **312** may include queue sub-systems located at each datacenter. This way, each datacenter (e.g., via a datacenter control system) may organize computational operations obtained at the datacenter until computing systems are able to start executing the computational operations. In some examples, the queue system **312** may move computational operations between different computing systems or different datacenters in real-time.

Within the arrangement of FIG. **9**, the queue system **312** is shown connected to the remote master control system **300** via the communication link **918**. In addition, the queue system **312** is also shown connected to the flexible datacenter via the communication **920**A and to the traditional datacenter **902** via the communication link **920**B. The communication links **918**, **920**A, **920**B may be similar to the communication link **916** and can be various types of communication links within examples.

The queue system **312** may include a computing system configured to organize and maintain queues within the queue system **312**. In another example, one or more other components of the system may maintain and support queues within the queue system **312**. For instance, the remote master control system **300** may maintain and support the queue system **312**. In other examples, multiple components may maintain and support the queue system **312** in a distributed manner, such as a blockchain configuration.

In some embodiments, the remote master control system **300** may serve as an intermediary that facilitates all communication between flexible datacenter **500** and the traditional datacenter **902**. Particularly, the traditional datacenter **902** or the flexible datacenter **500** might need to transmit communications to the remote master control system **300** in order to communicate with the other datacenter. As also shown, the remote master control system **300** may connect to the queue system **312** via the communication link **918**. Computational operations may be distributed between the queue system **312** and the remote master control system **300** via the communication link **918**. The computational operations may be transferred in real-time and mid-performance from one datacenter to another (e.g., from the traditional datacenter **902** to the flexible datacenter **500**). In addition, the remote master control system **300** may manage the queue system **312**, including providing resources to support queues within the queue system **312**.

As a result, the remote master control system **300** may offload some or all of the computational operations assigned to the traditional datacenter **902** to the flexible datacenter **500**. This way, the flexible datacenter **500** can reduce overall computational costs by using the behind-the-meter power to provide computational resources to assist traditional datacenter **902**. The remote master control system **300** may use the queue system **312** to temporarily store and organize the offloaded computational operations until a flexible datacenter (e.g., the flexible datacenter **500**) is available to perform them. The flexible datacenter **500** consumes behind-the-meter power without transmission or distribution costs, which lowers the costs associated with performing computational operations originally assigned to the traditional datacenter **902**. The remote master control system **300** may further communicate with the flexible datacenter **500** via communication link **922** and the traditional datacenter **902** via the communication link **924**.

FIG. **10**A shows method **1000** of dynamic power consumption at a flexible datacenter using behind-the-meter power according to one or more example embodiments. Other example methods may be used to manipulate the power delivery to one or more flexible datacenters.

In step **1010**, the datacenter control system, the remote master control system, or another computing system may monitor behind-the-meter power availability. In some embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1020**, the datacenter control system or the remote master control system **300** may determine when a datacenter ramp-up condition is met. In some embodiments, the datacenter ramp-up condition may be met when there is sufficient behind-the-meter power availability and there is no operational directive from the generation station to go offline or reduce power.

In step **1030**, the datacenter control system may enable behind-the-meter power delivery to one or more computing systems. In some instances, the remote mater control system may directly enable BTM power delivery to computing systems within the flexible system without instructing the datacenter control system.

In step **1040**, once ramped-up, the datacenter control system or the remote master control system may direct one or more computing systems to perform predetermined computational operations. In some embodiments, the predetermined computational operations may include the execution of one or more distributed computing processes, parallel processes, and/or hashing functions, among other types of processes.

While operational, the datacenter control system, the remote master control system, or another computing system may receive an operational directive to modulate power consumption. In some embodiments, the operational directive may be a directive to reduce power consumption. In such embodiments, the datacenter control system or the remote master control system may dynamically reduce power delivery to one or more computing systems or dynamically reduce power consumption of one or more computing systems. In other embodiments, the operational directive may be a directive to provide a power factor correction factor. In such embodiments, the datacenter control system or the remote master control system may dynamically adjust power delivery to one or more computing systems to achieve a desired power factor correction factor. In still other embodiments, the operational directive may be a directive to go offline or power down. In such embodiments, the datacenter control system may disable power delivery to one or more computing systems.

FIG. **10**B shows method **1050** of dynamic power delivery to a flexible datacenter using behind-the-meter power according to one or more embodiments. In step **1060**, the datacenter control system or the remote master control system may monitor behind-the-meter power availability. In

certain embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1070**, the datacenter control system or the remote master control system may determine when a datacenter ramp-down condition is met. In certain embodiments, the datacenter ramp-down condition may be met when there is insufficient behind-the-meter power availability or anticipated to be insufficient behind-the-meter power availability or there is an operational directive from the generation station to go offline or reduce power.

In step **1080**, the datacenter control system may disable behind-the-meter power delivery to one or more computing systems. In step **1090**, once ramped-down, the datacenter control system remains powered and in communication with the remote master control system so that it may dynamically power the flexible datacenter when conditions change.

One of ordinary skill in the art will recognize that a datacenter control system may dynamically modulate power delivery to one or more computing systems of a flexible datacenter based on behind-the-meter power availability or an operational directive. The flexible datacenter may transition between a fully powered down state (while the datacenter control system remains powered), a fully powered up state, and various intermediate states in between. In addition, flexible datacenter may have a blackout state, where all power consumption, including that of the datacenter control system is halted. However, once the flexible datacenter enters the blackout state, it will have to be manually rebooted to restore power to datacenter control system. Generation station conditions or operational directives may cause flexible datacenter to ramp-up, reduce power consumption, change power factor, or ramp-down.

FIG. **11** illustrates a block diagram of a system for implementing control strategies based on a power option agreement, according to one or more embodiments. The system **1100** represents an example arrangement that includes a control system (e.g., the remote master control system **262**), a load (e.g., one or more of the datacenters **1102**, **1104**, and **1106**), and a power entity **1140**, which may establish and operate in accordance with a power option agreement. Additional arrangements are possible within examples.

In general, a power option agreement is an agreement between a power entity **1140** associated with the delivery of power to a load (e.g., a grid operator, power generation station, or local control station) and the load (e.g., the datacenters **1102-1106**). As part of the power option agreement, the load (e.g., load operator, contracting agent for the load, semi-automated control system associated with the load, and/or automated control system associated with the load) provides the power entity **1140** with the right, but not obligation, to reduce the amount of power delivered (e.g., grid power) to the load up to an agreed amount of power during an agreed upon time interval. In order to provide the power entity **1140** with this option, the load needs to be using at least the amount of power subject to the option (e.g., a minimum power threshold). For instance, the load may agree to use at least 1 MW of grid power at all times during a specified 24-hour time interval to provide the power entity **1140** with the option of being able to reduce the amount of power delivered to the load by any amount up to 1 MW at any point during the specified 24-hour time interval. The load may grant the power entity **1140** with this option in exchange for a monetary consideration (e.g., receive power at a reduced price and/or monetary payment if the option is exercised by the power entity).

The power option agreement may be used by the power entity **1140** to reserve the right to reduce the amount of grid power delivered to the load during a set time frame (e.g., the next 24 hours). For instance, the power entity **1140** may exercise a predefined power option to reduce the amount of grid power delivered to the load during a time when the grid power may be better redirected to other loads coupled to the power grid. As such, the power entity **1140** may exercise power option agreements to balance loads coupled to the power grid. In some embodiments, a power option agreement may also specify other parameters, such as costs associated with different levels of power consumption and/or maximum power thresholds for the load to operate according to.

To illustrate an example, a power option agreement may specify that a load (e.g., the datacenters **1102-1106**) is required to use at least 10 MW or more at all times during the next 12 hours. Thus, the minimum power threshold according to the power option agreement is 10 MW and this minimum power threshold extends across the time interval of the next 12 hours. In order to comply with the agreement, the load must subsequently operate using 10 MW or more power at all times during the next 12 hours. This way, the load can accommodate a situation where the power entity **1140** exercises the option. Particularly, exercising the option may trigger the load to reduce the amount of power it consumes by an amount up to 10 MW at any point during the 12 hour interval. By establishing this power option agreement, the power entity **1140** can manipulate the amount of power consumed at the load during the next 12 hours by up to 10 MW if power needs to be redirected to another load or a reduction in power consumption is needed for other reasons.

In the example arrangement of the system **1100** shown in FIG. **11**, one or more of the datacenters (e.g., the flexible datacenters **1102**, **1104**, and the traditional datacenter **1106**) may operate as the load that is subject to a power option agreement. As the load that is subject to the power option agreement, the datacenters **1102-1106** may execute control instructions in accordance with power target consumption targets that meet or exceed the minimum power thresholds based on the power option agreement.

As shown in FIG. **11**, each datacenter **1102-1106** may include a set of computing systems configured to perform computational operations using power from one or more power sources (e.g., BTM power, grid power, and/or grid power subject to a power option agreement). In particular, the flexible datacenter **1102** includes computing systems **1108** arranged into a first set **1114**A, a second set **1114**B, and a third set **1114**C, the flexible datacenter **1104** includes computing systems **1110** arranged into a first set **1116**A, a second set **1116**B, and a third set **1118**B, and the traditional datacenter **1106** includes computing systems **1112** arranged into a first set **1118**A, a second set **1118**B, and a third set **1118**C. Each set of computing systems may include various types of computing systems that can operate in one or more modes.

The different sets of computing systems as well as the multiple datacenters are included in FIG. **11** for illustration purposes. In particular, the variety of computing systems represent different configurations that a load may take while operating in accordance with a power option agreement, and each configuration (as detailed herein) may include ramping up or down power consumption and transferring and performing computational operations between sets of comput-

ing systems and/or datacenters. In other examples, the load that is subject to a power option agreement may take on other configurations (e.g., a single datacenter **1102-1106**, and/or a single set of computing systems).

The remote master control system **262** may serve as a control system that can determine performance strategies and provide control instructions to the load (e.g., one or more of the datacenters **1102-1106**). In particular, the remote master control system **262** can monitor conditions in concert with the minimum power thresholds and time intervals (e.g., power option data) set forth in, and/or derived from, one or more power option agreements to determine performance strategies that can enable the load to meet the expectations of the power option agreement(s) while also efficiently using power to accomplish computational operations. In some instances, the remote master control system **262** may also be subject to the power option agreement and may adjust its own power consumption based on the power option agreement (e.g., ramp up or down power consumption based on the defined minimum power thresholds during time intervals).

To establish a power option agreement, the remote master control system **262** (or another computing system) may communicate with the power entity **1140**. For instance, the remote master control system **262** may provide a request (e.g., a signal and/or a bid) to the power entity **1140** and receive the terms of one or more power option agreements, or power option data related to power option agreements (e.g., data such as minimum power thresholds and time intervals, but not all terms contained within a potential power option agreement) in response. In some examples, the remote master control system **262** may evaluate one or more conditions prior to establishing a power option agreement to ensure that the conditions could enable the load (e.g., the datacenters **1102-1106**) to operate in accordance with the power option agreement. For instance, the remote master control system **262** may check the quantity and deadlines associated with computational operations assigned to specific datacenters prior to establishing specific datacenters as a load subject to a power option agreement. In some cases, multiple power option agreements may be established. For example, each datacenter **1102-1106** may be subject to a different power option agreement, which may result in the remote master control system **262** managing the power consumption at each of the datacenters **1102-1106** differently.

Within the system **1100** shown in FIG. **11**, the power entity **1140** may represent any type of power entity associated with the delivery of power to the load that is subject to a power option agreement. For instance, the power entity **1140** may be a local station control system, a grid operator, or a power generation source. As such, the power entity **1140** may establish power option agreements with the loads via communication with the loads and/or the remote master control system **262**. For example, the power entity **1140** may obtain and accept a bid from a load trying to engage in a power option agreement with the power entity **1140**. The power entity **1140** is shown with a power option module **1142**, which may be used to establish power option agreements (e.g., fixed-duration 1144 and/or dynamic **1146**).

Once a power option agreement is established, the remote master control system **262** may obtain power option data from the power entity **1140** (or another source) that specifies the power and time expectations of the power entity **1140**. As shown in FIG. **11**, the power entity **1140** includes a power option module **1142**, which may be used to provide power option data to the remote master control system **262** and/or the datacenters **1102-1106**. In particular, the power option data may specify the minimum power threshold or thresholds associated with one or more time intervals for the load to operate at in accordance with based on the power option agreement. The power option data may also specify other constraints that the load should operate in accordance with.

In some examples, the power option data may also include an indication of a monetary penalty that would be imposed upon the load for failure to operate as agreed upon for the power option agreement. In addition, the power option data may also include an indication of a monetary benefit provided to the load operating at power consumption levels that are in accordance with a power option agreement. For instance, monetary benefits could include reduced prices for power, credits for power, and/or monetary payments. In addition, the power option data may include further constraints upon power use, such as one or more maximum power thresholds and corresponding time intervals for the maximum power thresholds.

In some embodiments, the power entity **1140** may correspond to a qualified scheduling entity (QSE). A QSE may submit bids and offers on behalf of resource entities (REs) or load serving entities (LSEs), such as retail electric providers (REPs). QSEs may submit offers to sell and/or bids to buy power (energy) in the Day-Ahead Market (e.g., the next 24 hours) and the Real-Time Market. As such, the remote master control system **262** or another computing system may communicate with one or more QSEs to engage and control one or more loads in accordance with one or more power option agreements.

In some examples, a power option agreement may take the form of a fixed duration power option agreement **1144**. The fixed duration power option agreement **1144** may specify a set of minimum power thresholds and a set of time intervals in advance for an upcoming fixed duration of time covered by the agreement. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. Examples of such association are provided in FIG. **12**. The fixed duration power option agreement may be established in advanced of the time period covered by the set of time intervals to enable the remote master control system **262** to prepare performance strategies for the load (e.g., the datacenter(s)) associated with the power option agreement. Thus, the remote master control system **262** may evaluate the fixed duration power option and other monitored conditions to determine performance strategies for a set of computing systems (e.g., one or more datacenters) during the different intervals that satisfy the minimum power thresholds.

In other examples, a power option agreement may take the form of a dynamic power option agreement **1146**. For a dynamic power option agreement **1146**, minimum power thresholds may be provided to the remote master control system **262** in real-time (or near real-time). For instance, a dynamic power option agreement may specify that the power entity **1140** may provide adjustments to minimum power thresholds and corresponding time intervals in real-time to the remote master control system **262**. For example, a dynamic power option agreement may provide power option data that specifies a minimum power threshold for immediate adjustments (e.g., for the next hour).

In an embodiment, a dynamic power option agreement **1146** may involve repeat communication between the remote master control system **262** and the power entity **1140**. Particularly, the power entity **1140** may provide signals to the remote master control system **262** that request power consumption adjustments to be initiated at one or more

datacenters by the remote master control system **262** over short time intervals, such as across minutes or seconds. For example, the power entity **1140** may communicate to the remote master control system **262** to ramp power consumption down to a particular level within the next 5 minutes. As a result, the remote master control system **262** may provide instructions to one or more datacenters to ramp down power consumption using a linear ramp over the next 5 minutes to meet the particular level specified by the power entity **1140**. The remote master control system **262** may monitor the linear ramp down of power consumption and increase or decrease the rate that the datacenter(s) ramp down power use based on projections and updates received from the power entity **1140**. As a result, although the ramp down of power consumption may initially be performed in a linear manner to meet a power target threshold, the remote master control system **262** may adjust the rate of power consumption decrease based on updates from the power entity **1140**. For example, 25 percent of the overall power consumption ramp down may occur during a first period (e.g., 4 minutes 30 seconds) of the 5 minutes and the remaining 75 percent of the overall power consumption ramp down may occur during the remaining period of the 5 minutes (e.g., the final 30 seconds). The example percentages are included for illustration purposes and can vary within examples based on various parameters, such as additional communication (e.g., adjustments) provided by the power entity **1140**.

In further examples, a power option agreement may operate similarly to both a fixed-duration 1144 and a dynamic power option agreement **1146**. Particularly, power option data specifying minimum power thresholds and corresponding time intervals may be provided in advance for the entire fixed-duration of time (e.g., the next 24 hours). Additional power option data may then be subsequently provided enabling the remote master control system **262** to make one or more adjustments to accommodate any changes specified within the additional power option data. For instance, additional power option data may indicate that a power entity exercised its option to deliver less power to the load. As a result, the remote master control system may instruct the load to adjust power consumption based on the power entity reducing the power threshold minimum via exercising the option.

As indicated above, the remote master control system **262** may monitor conditions in addition to the constraints set forth in power option data received from the power entity **1140**. Particularly, the remote master control system **262** may monitor and analyze a set of conditions (including the power option data) to determine strategies for assigning, transferring, and otherwise managing computational operations using the one or more datacenters **1102-1106**. The determined strategies may enable efficient operation by the datacenters while also ensuring that the datacenters operate at target power consumption levels that meet or exceed the minimum power thresholds set forth within one or more power option agreements.

Example monitored conditions include, but are not limited to, power availability **1120**, power prices **1122**, computing systems parameters **1124**, cryptocurrency prices **1126**, computational operation parameters **1128**, and weather conditions **1129**. Power availability **1120** may include determining power consumption ranges at a set of computing systems and/or at one or more datacenters. In addition, power availability **1120** may also involve determining the source or sources of power available at a datacenter. For instance, the remote master control system **262** may identify the types of power sources (e.g., BTM, grid power, and/or a battery system) that a datacenter has available. Power prices **1122** may involve an analysis of the different costs associated with powering a set of computing systems. For instance, the remote master control system **262** may determine cost of power from the grid without a power option agreement relative to the cost power from the grid under the power option agreement. In addition, the remote master control system **262** may also compare the cost of grid power relative to the cost of BTM power when available at a datacenter. The power prices **1122** may also involve comparing the cost of using power at different datacenters to determine which datacenter may perform computational operations at a lower cost.

Monitoring computing system parameters **1124** may involve determining parameters related to the computing systems at one or more datacenters. For instance, the remote master control system **262** may monitor various parameters of the computing systems at a datacenter, such as the abilities and availability of various computing systems, the status of the queue used to store computational operations awaiting performance by the computing systems. The remote master control system **262** may determine types and operation modes of the computing systems, including which computing systems could operate in different modes (e.g., a higher power or a lower power mode) and/or at different hash rates and/or frequencies. The remote master control system **262** may also estimate when computing systems may complete current computational operations and/or how many computational operations are assigned to computing systems.

Monitoring cryptocurrency prices **1126** may involve monitoring the current price of one or more cryptocurrencies, the hash rate and/or estimated power consumption associated with mining each cryptocurrency, and other factors associated with the cryptocurrencies. The remote master control system **262** may use data related to monitoring cryptocurrency prices **1126** to determine whether using computing systems to mine a cryptocurrency generates more revenue than the cost of power required for performance of the mining operations.

The remote master control system **262** may monitor parameters related to computational operations (e.g., computational operation parameters **1128**). For example, the remote master control system **262** may monitor parameters related to the computational operations requiring performance and currently being performed, such quantity of operations, estimated time to complete, cost to perform each computational operation, deadlines and priorities associated with each computational operation. In addition, the remote master control system **262** may analyze computational operations to determine if a particular type of computing system may perform the computational operation better than other types of computing systems.

Monitoring weather conditions **1129** may include monitoring for any potential power generation disruption due to emergencies or other events, and changes in temperatures or weather conditions at power generators or datacenters that could affect power generation. As such, the operations and environment analysis module (or another component) of the remote master control system **262** may be configured to monitor one or more conditions described above.

The performance strategy determined by the remote master control system **262** based on the monitored conditions and/or power option data can include control instructions for the load (e.g., the datacenters and/or one or more sets of computing systems). For instance, a performance strategy can specify operating parameters, such as operating frequen-

cies, power consumption targets, operating modes, power on/off and/or standby states, and other operation aspects for computing systems at a datacenter.

The performance strategy can also involve aspects related to the assignment, transfer, and performance of computational operations at the computing systems. For instance, the performance strategy may specify computational operations to be performed at the computing systems, an order for completing computational operations based on priorities associated with the computational operations, and an identification of which computing systems should perform which computational operations. In some instances, priorities may depend on revenue associated with completing each computational operation and deadlines for each computational operation.

The monitored conditions may enable efficient distribution and performance of computational operations among computing systems at one or more datacenters (e.g., datacenters **1102-1106**) in ways that can reduce costs and/or time to perform computational operations, take advantage of availability and abilities of computing systems at the datacenters **1102-1106**, and/or take advantage in changes in the cost for power at the datacenters **1102-1106**. In addition, the monitored conditions may also involve consideration of the power option data to ensure that the computing systems consume enough power to meet minimum power thresholds set forth in one or more power option agreements.

The various monitored conditions described above as well as other potential conditions may change dynamically and with great frequency. Thus, to enable efficient distribution and performance of the computational operations at the datacenters, the remote master control system **262** may be configured to monitor changes in the various conditions to assist with the efficient management and operations of the computing systems at each datacenter. For instance, the remote master control system **262** may engage in wired or wireless communication **1130** with datacenter control systems (e.g., datacenter control system **504**) at each datacenter as well as other sources (e.g., the power entity **1140**) to monitor for changes in the conditions.

The remote master control system **262** may analyze the different conditions in real-time to modulate operating attributes of computing systems at one or more of the datacenters. By using the monitored conditions, the remote master control system **262** may increase revenue, decrease costs, and/or increase performance of computational operations via various modifications, such as transferring computational operations between datacenters or sets of computing systems within a datacenter and adjusting performance at one or more sets of computing systems (e.g., switching to a low power mode).

In some examples, the traditional datacenter **1106** may be the load subject to a power option agreement. As such, the remote master control system **262** may factor the power option agreement when determining whether to perform computational operations using the computing systems **1112** at the traditional datacenter **1106** and/or transfer computational operations to the computing systems **1108**, **1110** at the flexible datacenters **1102**, **1104**. For instance, the monitored conditions may indicate that the price of grid power is substantially higher than BTM power. As a result, the remote master control system **262** may transfer a subset of computational operations from the traditional datacenter **1106** to the flexible datacenters **1102**, **1104**. The traditional datacenter **1106** may still have some computational operations to perform to ensure that the traditional datacenter **1106** is using enough power to meet the minimum power threshold or thresholds set forth in the power option agreement.

In some examples, the remote master control system **262** may monitor the grid frequency signal received from the power entity **1140**. When the frequency of the grid deviates a threshold amount (e.g., 0.036 Hz above or below 60 Hz), the remote master control system **262** may adjust performance strategies at the load. In some cases, the remote master control system **262** may adjust the power consumption at the load, the number of miners (or computing systems) operating at the load, and/or the frequency or hash rate, among other possible changes. The remote master control system may readjust performance strategies at the load in response to receiving additional power option data from the power entity **1140** (e.g., an indication that the frequency of the grid is back to 60 Hz). In addition, the remote master control system **262** may communicate changes in operations at the load to the power entity **1140**. This way, the power entity **1140** may obtain confirmation that the load is adjusting in accordance with a power option agreement.

In some embodiments, a power generation source (e.g., the generation station **400** shown in FIG. **4**) may enter into a power option agreement with a grid operator, which may provide the grid operator with the option to reduce the amount of power that the power source generator can deliver to the grid during a defined time interval. For instance, a wind generation farm may enter into the power option agreement with the grid operator. In addition, the remote master control system **262** may also enter into a power option agreement with the power generation source (e.g., the wind farm) to provide a load that can receive excess power from the power generation source when the grid operator exercises the option and lowers the amount of power that the power generation source can deliver to the grid. Thus, rather than reducing the amount of power produced, the power generation source could exercise an option in the agreement with remote master control system **262** and redirect excess power to one or more loads (e.g., a set of computing systems) that could ramp up power consumption in response. In such situations, the remote master control system **262** maybe able to use the excess power from the power generation source (e.g., BTM power) to perform operations at one or more loads at a low cost (or no cost at all). In addition, the power generation source may benefit from the power option agreement by directing excess power to the load instead of temporarily halting power production.

In some examples, a power option agreement may depend on parameters associated balancing grid capacity and demand. For instance, power option agreements may incentivize power consumption ramping during periods of peak grid power use.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments. The graph **1200** shows power option data arranged according to power **1204** over time **1202**. As shown in FIG. **12**, time **1202** increases along the X-axis and minimum power thresholds **1204** increase along the Y-axis of the graph **1200**. In the example embodiment shown in FIG. **12**, the time **1202** increases up to a full day (e.g., 24 hours) in 4 hour increments and the power is shown in MW increasing in intervals of 5 MW. The 24 duration and example minimum power thresholds can differ in other embodiments. Particularly, these values may depend on the terms set forth within the power option agreement.

The graph line **1206** represents sets of minimum power thresholds **1206**A, **1206**B, **1206**C that are specified by

power option data based on the power option agreement. As shown, the graph line **1206** extends the entire 24 hour duration, which indicates that the set of time intervals associated with minimum power thresholds add up to 24 hours. In other examples, the power option agreement may not include a minimum power threshold during a portion of the duration.

The graph line **1206** of the graph **1200** is further used to illustrate power consumption levels that one or more loads (e.g., a set of computing systems) operating according to the power option agreement may utilize during the 24 hour duration. Particularly, the power quantities above the graph line **1206** represents power levels that the load(s) may consume from the power grid during the 24 hour duration that would satisfy the requirements (i.e., the minimum power thresholds **1206**A-**1206**C) set forth by the power option agreement. In particular, the power quantities above the graph line **1206** include any power quantity that meets or exceeds the minimum power threshold at that time. By extension, the power quantities positioned below the graph line **1206** represents the amount of power that the load could be directed to reduce power consumption by per the power option agreement.

To further illustrate, an initial minimum power threshold **1206**A is shown associated with the time interval starting at hour 0 and extending to hour 8. In particular, the minimum power threshold **1206**A is set at 5 MW during this time interval. Thus, based on the power option data shown in FIG. **12**, the loads must be able to operate at a target power consumption level that is equal to or greater than the 5 MW minimum power threshold **1206**A at all times during the time interval extending from hour 0 to hour 8, in order to be able to satisfy the power option if it is exercised for that time interval. Similarly, the power entity could reduce the power consumed by loads by any amount up to 5 MW at any point during the time interval from hour 0 to hour 8 in accordance with the power option agreement. For instance, the power entity could exercise its option at any point during this time interval to reduce the power consumed by the loads by 3 MW as a way to load balance the power grid. In response to the power entity exercising its option, the load may then operate using 3 MW less power and/or another strategy determined by a control system factoring additional conditions (e.g., the price of grid power, the revenue that could be generated from mining a cryptocurrency, and/or parameters associated with computational operations awaiting performance)

As further shown in the graph **1200** illustrated in FIG. **12**, the next minimum power threshold **1206**B is associated with the following time interval, which starts at hour 8 and extends until hour 16. During this time interval (hour 8 to hour 16), the load(s) may consume 10 MW or more power since the minimum power threshold **1206**B is now set at 10 MW as shown on the Y-axis of the graph **1200**. In light of the power option data, a control system may determine and provide a performance strategy to the load (e.g., a set of computing systems) that includes a power consumption target that meets or exceeds the minimum power threshold **1206**B (i.e., 10 MW). The performance strategy may depend on the power option data as well as other possible conditions, such as the price of grid power, the availability of computing systems, and/or the type of computing operations, etc. In addition, the power entity could exercise its option to reduce the amount of power consumed by the load by 10 MW or less as represented by the power levels under the minimum threshold **1206**B that extend during the time interval of hour 8 to hour 16.

The last minimum power threshold **1206**C is associated with the time interval that starts at hour 16 and extends until hour 24. Similar to the initial minimum power threshold **1206**A associated with the beginning of the graph line **1206**, the last minimum power threshold **1206** is also set at 5 MW. As such, at any point during this interval (hour 16 to hour 24) the loads may consume 5 MW or more to operate in accordance with the power option agreement. As discussed above, by operating at 5 MW or more, the load enables the power consumed from the power grid to be reduced any amount from zero up to 5 MW during this time interval.

When determining the power consumption strategy for a load, a computing system (e.g., the remote master control system **262**) may consider various conditions in addition to the power option data received based on one or more power option agreements. Particularly, the computing system may consider and weigh different conditions in addition to the power option data to determine power consumption targets and/or other control instructions for a load. The conditions may include, but are not limited to, the price of grid power, the price of alternative power sources (e.g., BTM power, stored energy), the revenue associated with mining for one or more cryptocurrencies, parameters related to the computational operations requiring performance (e.g., priorities, deadlines, status of the queue organizing the operations, and/or revenue associated with completing each computational operation), parameters related to the set of computing systems (e.g., types and availabilities of computing systems), and other conditions (e.g., penalties if a minimum power threshold is not met and/or monetary benefits from operating under a power option agreement). By weighing various conditions, the computing system may efficiently manage the set of computing systems, including enabling performance of computational operations cost effectively and/or ensuring at that computing systems operate at target power consumption levels that one or more satisfy power option agreements.

In some examples, the computing system may decrease the amount of power that a set of computing systems consumes from one source and while also increasing the amount of power that the set consumes from another source. For instance, the computing system may determine that the price of power grid power is above a threshold price that makes computational operations relatively expensive to perform using grid power. As a result, the computing system may provide control instructions for the computing systems to consume power grid power that matches a minimum power threshold specified by power option data. This may enable the computing systems to satisfy the power option agreement while also avoiding using pricey grid power beyond the minimum amount required per the power option data. In addition, the computing system may instruct some computing systems to switch to a low power mode or temporarily stop until the price of power from the grid decreases. The computing system may instruct one or more computing systems to operate using power from another source (e.g., BTM power and/or stored energy from a battery system) and/or transfer one or more computational operations to another set of computing systems (e.g., a different datacenter).

When the power option agreement is a fixed duration power option agreement, the computing system may receive an indication of all the minimum power thresholds **1206**A-**1206**C and an indication of the associated time interval altogether and in advance of the duration associated with the power option agreement. By providing all of the minimum power thresholds **1206**A-**1206**C and the time intervals in

advance, the computing system may determine a performance strategy for the load that can extend across the entire duration. Particularly, the computing system may factor the minimum power thresholds and associated time intervals as well as other monitored conditions to determine the performance strategy for the total duration. This can enable the computing system to accept and assign computational operations to computing systems in advance while also using a performance strategy that meets the expectations of a power option agreement.

In some examples, the performance strategy determined by the computing system may include control instructions for the set of computing systems to execute if a power option is exercised. For instance, the performance strategy may specify different power consumption targets for the computing systems that depend on whether a power option is exercised during each time interval.

In some instances, the computing system may modify the performance strategy when one or more conditions change enough to warrant a modification. For instance, the computing system may receive an indication of a change in a minimum power threshold (e.g., a decrease in the minimum power threshold) and determine one or more modifications based on the new minimum power threshold and/or other conditions (e.g., a change in the price of power).

In other examples, the power option agreement may be a dynamic power option agreement. Particularly, the load may be subject to a changing minimum power threshold that can vary during a predefined duration associated with the power option agreement. For example, a dynamic power option agreement may specify that the load is subject to a minimum power threshold that may vary from 0 MW up to 5 MW during the next 24 hours and the particular minimum threshold for each hour may depend on power option data received from the power entity during the prior hour. The dynamic power option agreement may further specify the expected response time from the load. For instance, the power option agreement may indicate that an indication of a new minimum power threshold will be provided an hour prior to the start of the minimum power threshold. The computing system, for example, may receive an indication at hour 7 about the increase in the minimum power threshold **1206**B starting at hour 8. The indication may (or may not) specify the total time interval associated with a new minimum power threshold. For instance, the indication received by the computing system may specify that the 10 MW minimum power threshold **1206**B extends from hour 8 until hour 16. In other instances, the power option data may indicate that the computing system should abide by the new minimum power threshold until receiving further power option data indicating a change to another new minimum power threshold.

In some examples, the power option data may arrive at the computing system in an unknown order from the power entity with expectations of swift power consumption adjustments by the load. As a result, the power option agreement may require fast ramping of the load to meet changes. Ramping may involve ramping up or down power consumption as well as ramping operating techniques (e.g., adjusting frequency or operation mode).

In some embodiments, the type of power option power agreement may depend on the delivery and content of power option data provided to the load (or a control system controlling the load). For instance, a computing system may receive minimum power thresholds set across an entire duration associated with a power option agreement in advance when the power option agreement is a fixed-duration power option agreement. In other instances, the computing system may receive power option data dynamically and adjust operations in real-time (or near real-time). For instance, the computing system may receive a series of power option data that each specifies minimum power threshold changes during the duration set forth in the dynamic power option agreement. To illustrate an example, the computing system may receive power option data during hour 1 that specifies the minimum power threshold for hour 2, power option data during hour 2 that specifies the minimum power threshold for hour 3, and so on across the duration of the dynamic power option agreement.

In some examples, the minimum power threshold for a time interval may be zero during the duration of a power option agreement. As such, the load may use any amount of power from the power grid in accordance with the power option agreement, including no power at all during this time interval. When the price for power is high during this time frame, the load may ramp down power usage to zero MW to avoid paying the high price for power while still being in compliance with the power option agreement.

FIG. **13** illustrates a method for implementing control strategies based on a fixed-duration power option agreement, according to one or more embodiments. The method **1300** serves as an example and may include other steps within other embodiments. A control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1300**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At step **1302**, the method **1300** involves monitoring a set of conditions. For instance, a computing system (e.g., a control system) may monitor various conditions that could impact the performance of operations at one or more loads, including the power consumption targets at the loads. The set of monitored conditions may include a variety of information obtained from one or more external sources, such as one or more datacenters, databases, power generation stations, or types of sources.

Some example conditions include, but are not limited to, the price of grid power, the price and availability of alternative power options (e.g. BTM power, and/or stored energy), parameters of the load (e.g., ramping abilities, type of computing systems, operation modes, etc.), parameters of tasks to be performed using the power at the load (e.g., types, deadlines, priorities, and/or revenue associated with computational operations), availability of other computing systems and their associated costs, and/or revenue associated with mining a cryptocurrency. The computing system may monitor one or more of these conditions as well as others.

At step **1304**, the method **1300** involves receiving power option data based, at least in part, on a power option agreement. As discussed above, the computing system (e.g., a remote master control system) may engage in a power option agreement with a power entity. As a result, the computing system may control a load (e.g., a set of computing systems) in accordance with power thresholds and time intervals received from the power entity based on the power option agreement.

In some examples, the power option data may specify a set of minimum power thresholds and a set of time intervals. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. To illustrate an example, the power option data may specify a first minimum power threshold

associated with a first time interval and a second minimum power threshold associated with a second time interval, with the second time interval subsequent to the first time interval.

The set of time intervals may add up to the duration represented by the power option agreement. For instance, the total duration of the set of time intervals may correspond to a twenty-four hour period (e.g., the next day). In other examples, the power option agreement may span across a different duration (e.g., 12 hours). In additional embodiments, the power option data may specify other information, such as monetary incentives associated with parameters of the power option agreement and/or one or more maximum power thresholds.

At step **1306**, the method **1300** involves determining a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy may be determined responsive to receiving the power option data. In addition, the performance strategy may include a power consumption target for the set of computing systems for each time interval in the set of time intervals. In some examples, each power consumption target is equal to or greater than the minimum power threshold associated with each time interval.

As an example, the performance strategy may specify a first power consumption target for the set of computing systems for a first time interval such that the first power consumption target is equal to or greater than a first minimum power threshold associated with the first time interval and a second power consumption target for the set for a second time interval in a similar manner (i.e., the second power consumption target is equal to or greater than a second minimum power threshold).

In some examples, the performance strategy may include an sequence for the set of computing systems to follow when performing computational operations. The sequence, for example, may be based on priorities associated with the computational operations. In addition, the performance strategy may include one or more power consumption targets that are greater than the minimum power thresholds when the price of power from the power grid is below a threshold price during the time intervals associated with the minimum power thresholds.

The performance strategy may also involve transferring, delaying, or adjusting one or more computational operations performed at the set of computing systems. In addition, the performance strategy may involve adjusting operations at the computing systems. For instance, one or more computing systems may switch modes (e.g., operate at a higher frequency or switch to a low power mode).

In addition, the performance strategy may also specify power consumption targets for the set of computing systems to use if the power option is exercised during an interval. This way, the computing systems may continue to perform computational operations (or suspend performance) based on the power option being exercised.

At step **1308**, the method **1300** involves providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy. For example, the set of computing systems may operate according to the performance strategy to ensure that the minimum power thresholds are met during the defined time intervals based on the power option agreement.

Some examples may further involve receiving subsequent power option data based, at least in part, on the power option agreement. The subsequent power option data may specify to decrease one or more minimum power thresholds of the set of power thresholds. Responsive to receiving the subsequent power option data, the performance strategy for the set of computing systems may be modified based on a combination of at least a portion of the subsequent power option data and one or more conditions of the monitored conditions. The modified performance strategy may include one or more reduced power consumption targets for the set of computing systems. The amount of the reduction in a power consumption target may depend linearly with the amount that the corresponding minimum power threshold was reduced by. For instance, when a minimum power threshold for a time interval is reduced from 10 MW to 5 MW, the power consumption target for that time interval may be reduced from 10 MW to 5 MW. Instructions may be provided to the set of computing systems to perform computational operations based on the modified performance strategy.

FIG. **14** illustrates a method for implementing control strategies based on a dynamic power option agreement, according to one or more embodiments. The method **1400** serves as an example and may include other steps within other embodiments. Similar to the method **1400**, a control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1400**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At block **1402**, the method **1400** involves monitoring a set of conditions. Similar to block **1302** of the method **1300**, a computing system may monitor various conditions to determine instructions for controlling a set of computing systems.

At block **1404**, the method **1400** involves receiving first power option data based, at least in part, on a power option agreement while monitoring the set of conditions. The first power option data may specify a first minimum power threshold associated with a first time interval. For example, the first power option data may specify a minimum power threshold of 10 MW for the next hour, which may start in an hour or less.

The power option agreement may correspond to a dynamic power option agreement in some examples. When managing a load with respect to a dynamic power option agreement, a computing system may receive power option data specifying changes in minimum power thresholds that a load (e.g., the set of computing systems) may be designated to use in the near term (e.g., the next hour). For example, the computing system may receive power option data during each hour of the duration specified by a power option agreement that indicates a minimum power threshold for the next hour.

At block **1406**, the method **1400** involves providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition. The first control instructions may be provided responsive to receiving the first power option data.

The first control instructions may include a first power consumption target for the set of computing systems for the first time interval. Particularly, the first power consumption target may be equal to or greater than the first minimum power threshold associated with the first time interval. For example, the first power consumption target may be greater than the first minimum power threshold when a cost of power from the power grid is below a threshold price during the first time interval. In other instances, the first power consumption target may be equal to the first minimum power

threshold when the cost of power from the power grid is greater than the threshold price.

In some examples, control instructions may specify a sequence for the computing systems to follow when performing computational operations. The sequence may be based on priorities associated with each computational operation.

The first control instructions may be determined based on a combination of the first power option data, the price of power from the power grid, and parameters associated with computational operations to be performed at the set of computing systems.

In some examples, the first control instructions may involve ramping up or down power consumption at the set of computing systems. The power consumption may be ramped up or down based on the first minimum power threshold and one or more other conditions (e.g., the price of power).

At block **1408**, the method **1400** involves receiving second power option data based, at least in part, on the power option agreement while monitoring the set of conditions. The computing system may receive the second power option data subsequent to receiving the first power option data. The second power option data may specify a second minimum power threshold associated with a second time interval. For example, the second minimum power threshold may be 7 MW over the duration of the upcoming hour. In other examples, the second minimum power threshold may differ as shown in FIG. **12**.

In some instances, the computing system may receive the second power option data during the first time interval such that the second time interval overlaps the first time interval. For instance, the computing system may receive the second power option data to enable real-time adjustments to be made to the power consumed at the set of computing systems.

At block **1410**, the method **1400** involves providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power option data and at least one condition. The second control instructions may be provided responsive to receiving the second power option data. The second control instructions may specify a second power consumption target for the set of computing systems for the second time interval. The second power consumption target may be equal to or greater than the second minimum power threshold associated with the second time interval.

In some examples, the computing system may provide a request to a QSE to determine the power option agreement. As such, the computing system may receive power option data (e.g., the first and second power option data) in response to providing the request to the QSE.

The computing system may monitor the price of power from the power grid, and the global mining hash rate and a price for a cryptocurrency (e.g., Bitcoin), among other conditions. The computing system may determine control instructions (e.g., the first and/or second control instructions) based on a combination of power option data, the price of power from the power grid, and the global mining hash rate and the price for the cryptocurrency. For instance, the computing system may cause one or more computing systems (e.g., a subset of computing systems) to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Advantages of one or more embodiments of the present invention may include one or more of the following:

One or more embodiments of the present invention provides a green solution to two prominent problems: the exponential increase in power required for growing blockchain operations and the unutilized and typically wasted energy generated from renewable energy sources.

One or more embodiments of the present invention allows for the rapid deployment of mobile datacenters to local stations. The mobile datacenters may be deployed on site, near the source of power generation, and receive low cost or unutilized power behind-the-meter when it is available.

One or more embodiments of the present invention provide the use of a queue system to organize computational operations and enable efficient distribution of the computational operations across multiple datacenters.

One or more embodiments of the present invention enable datacenters to access and obtain computational operations organized by a queue system.

One or more embodiments of the present invention allows for the power delivery to the datacenter to be modulated based on conditions or an operational directive received from the local station or the grid operator.

One or more embodiments of the present invention may dynamically adjust power consumption by ramping-up, ramping-down, or adjusting the power consumption of one or more computing systems within the flexible datacenter.

One or more embodiments of the present invention may be powered by behind-the-meter power that is free from transmission and distribution costs. As such, the flexible datacenter may perform computational operations, such as distributed computing processes, with little to no energy cost.

One or more embodiments of the present invention provides a number of benefits to the hosting local station. The local station may use the flexible datacenter to adjust a load, provide a power factor correction, to offload power, or operate in a manner that invokes a production tax credit and/or generates incremental revenue.

One or more embodiments of the present invention allows for continued shunting of behind-the-meter power into a storage solution when a flexible datacenter cannot fully utilize excess generated behind-the-meter power.

One or more embodiments of the present invention allows for continued use of stored behind-the-meter power when a flexible datacenter can be operational but there is not an excess of generated behind-the-meter power.

One or more embodiments of the present invention allows for management and distribution of computational operations at computing systems across a fleet of datacenters such that the performance of the computational operations take advantages of increased efficiency and decreased costs.

It will also be recognized by the skilled worker that, in addition to improved efficiencies in controlling power delivery from intermittent generation sources, such as wind farms and solar panel arrays, to regulated power grids, the invention provides more economically efficient control and stability of such power grids in the implementation of the technical features as set forth herein.

While the present invention has been described with respect to the above-noted embodiments, those skilled in the art, having the benefit of this disclosure, will recognize that other embodiments may be devised that are within the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the appended claims.

What is claimed is:

1. A system comprising:

a set of computing systems, wherein the set of computing systems is configured to perform computational operations using power from a power grid;

a control system configured to:

monitor a set of conditions;

receive power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

2. The system of claim 1, wherein the control system is configured to monitor the set of conditions comprising:

a price of power from the power grid; and

a plurality of parameters associated with one or more computational operations to be performed at the set of computing systems.

3. The system of claim 2, wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at least the portion option data, the price of power from the power grid, and the plurality of parameters associated with the one or more computational operations.

4. The system of claim 3, wherein the performance strategy further comprises:

an order for the set of computing systems to follow when performing the one or more computational operations, wherein the order is based on respective priorities associated with the one or more computational operations.

5. The system of claim 4, wherein the performance strategy further comprises:

at least one power consumption target that is greater than a minimum power threshold when the price of power from the power grid is below a threshold price during the time interval associated with the minimum power threshold.

6. The system of claim 1, wherein the control system is further configured to:

receive subsequent power option data based, at least in part, on the power option agreement,

wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

7. The system of claim 6, wherein the control system is further configured to:

responsive to receiving the subsequent power option data, modify the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions,

wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems.

8. The system of claim 7, wherein the control system is further configured to:

provide instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

9. The system of claim 1, wherein the control system is a remote master control system positioned remotely from the set of computing systems.

10. The system of claim 1, wherein the control system is a mobile computing device.

11. The system of claim 1, wherein the control system is configured to receive the power option data while monitoring the set of conditions.

12. The system of claim 1, wherein the control system is further configured to:

provide a request to a qualified scheduling entity (QSE) to determine the power option agreement; and

receive power option data in response to providing the request to the QSE.

13. The system of claim 1, wherein the power option data specify: (i) a first minimum power threshold associated with a first time interval in the set of time intervals, and (ii) a second minimum power threshold associated with a second time interval in the set of time intervals,

wherein the second time interval is subsequent to the first time interval.

14. The system of claim 13, wherein the control system is configured to:

determine the performance strategy for the set of computing systems such that the performance strategy comprises:

a first power consumption target for the set of computing systems for the first time interval, wherein the first power consumption target is equal to or greater than the first minimum power threshold; and

a second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

15. The system of claim 1, wherein a total duration of the set of time intervals corresponds to a twenty-four hour period.

16. The system of claim 1, wherein the set of conditions monitored by the control system further comprise:

a price of power from the power grid; and

a global mining hash rate and a price for a cryptocurrency; and

wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at the portion of the power option data, the price of power from the power grid, the global mining hash rate and the price for the cryptocurrency,

wherein the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

17. A method comprising:

monitoring, by a computing system, a set of conditions;

receiving, at the computing system, power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

18. The method of claim **17**, wherein determining the performance strategy for the set of computing systems comprises:

identifying information about the set of computing systems; and

determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems.

19. The method of claim **17**, further comprising:

receiving subsequent power option data based, at least in part, on the power option agreement, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds;

responsive to receiving the subsequent power option data, modifying the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions, wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems; and

providing instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

20. A non-transitory computer readable medium having stored therein instructions executable by one or more processors to cause a computing system to perform functions comprising:

monitoring a set of conditions;

receiving power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

* * * * *

EXHIBIT B

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Methods and Systems for Adjusting Power Consumption based on a Fixed-Duration Power Option Agreement

As the below named inventor, I hereby declare that:

This declaration is directed to:

■ The attached application, or

☐ United States application or PCT international application number ________________

filed on ________________.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Michael T. McNamara Date (Optional) : Dec 2, 2019

Signature: ________________

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Methods and Systems for Adjusting Power Consumption based on a Fixed-Duration Power Option Agreement

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number ____________________

filed on ____________________.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Raymond E. Cline Jr. Date (Optional): 12/3/2019

Signature: ____________________

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR. Defendants.	)	C.A. No. 21-534-MN **JURY TRIAL DEMANDED**

AMENDED COMPLAINT

Plaintiffs BearBox LLC ("BearBox") and Austin Storms (collectively, "Plaintiffs") bring this action against Lancium LLC ("Lancium"), Michael T. McNamara, and Raymond E. Cline, Jr. (collectively "Defendants") to correct the inventorship of U.S. Patent No. 10,608,433 (the "'433 Patent") and to recover damages, injunctive relief, declaratory relief, and other remedies for Defendants' wrongful actions to obtain, misuse, disclose, and claim as their own Plaintiffs' proprietary cryptocurrency mining technology. Plaintiffs further allege as follows:

INTRODUCTION

1. This case is about the Defendants' theft of inventions that rightfully belong to Plaintiffs.

2. ~~Plaintiffs developed~~Plaintiffs developed proprietary technology relating to cryptocurrency mining systems (the "BearBox Technology"). By way of background, the BearBox Technology generally relates to an energy-efficient cryptocurrency mining system and related methods that reduce the inefficiency and environmental impact of energy-expensive mining operations by better utilizing available energy resources to increase stability of the

{01690829;v1 }

energy grid, minimize a mining operation's impact on peak-demand, and also alleviate ~~electricity undersupply and/or oversupply conditions (the "BearBox Technology").~~energy over-supply conditions. The BearBox Technology can be used to mine cryptocurrency, such as Bitcoin.

3. The Defendants induced the Plaintiffs to disclose the BearBox Technology to them under the guise of a possible business deal between Defendants and Plaintiffs to jointly commercialize the BearBox Technology. Before disclosing the BearBox Technology to Defendants, Plaintiffs obtained assurances of confidentiality from Defendants.

4. ~~Rather than keeping the BearBox Technology confidential and using it in furtherance of a business relationship with Plaintiffs, the~~The Defendants stole the BearBox Technology from Plaintiffs by converting and misappropriating it and claiming it as their own. Defendants filed a U.S. patent application that wrongfully disclosed the BearBox Technology to the U.S. Patent and Trademark Office and ultimately to the public. The claimed subject matter of the '433 Patent falls fully within the scope of the BearBox Technology. And by obtaining the '433 Patent with claims directed to the BearBox Technology, the Defendants have wrongfully obtained a patent covering the BearBox Technology and wrongfully claimed the BearBox Technology as their own.

5. Plaintiffs bring this action to correct the named inventors on the '433 Patent. The inventions claimed in the '433 Patent are inventions conceived by Storms, founder and president of BearBox.

PARTIES

6. Plaintiff BearBox LLC ("BearBox") is a limited liability company organized and existing under the laws of Louisiana with its principal place of business at 4422 Highway 22, Mandeville, Louisiana 70471.

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7. Plaintiff Austin Storms is an individual residing in Mandeville, Louisiana.

8. On information and belief, Defendant Lancium is a Delaware limited liability company with its principal place of business at 6006 Thomas Rd, Houston, Texas 77041. On information and belief, Lancium has a registered agent capable of accepting service in this district, Harvard Business Services, Inc. with a place of business at 16192 Coastal Highway, Lewes, DE 19958.

9. On information and belief, Defendant Michael T. McNamara is the Chief Executive Officer and a founder of Lancium and resides in Newport Beach, California. Defendant McNamara is named as a purported inventor on the face of the ’433 Patent.

10. On information and belief, Defendant Raymond E. Cline, Jr. is the Chief Computing Officer of Lancium and resides in Houston, Texas. Defendant Cline is named as a purported inventor on the face of the ’433 Patent.

JURISDICTION

11. This is an action seeking correction of the named inventors of a United States patent under 35 U.S.C. § 256. As such, this action arises under the laws of the United States.

12. This Court has exclusive subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a) because the matter arises under an Act of Congress relating to patents, specifically 35 U.S.C. § 256.

~~13. This Court further has subject matter jurisdiction under 28 U.S.C. §§ 1331 because the matter arises under the trade secret laws of the United States, 18 U.S.C. § 1836.~~

~~14.~~13. The Court has supplemental jurisdiction under 28 U.S.C. § 1367 over all asserted claims under state law because those claims are so related to the claims in this action that arise under federal law that they form part of the same case or controversy.

~~15.~~14. The Court also has jurisdiction pursuant to 28 U.S.C. § 1332, as complete diversity of citizenship exists among the parties, and the amount in controversy exceeds $75,000. Plaintiff BearBox is a citizen of the State of Louisiana because it is organized under the laws of the State of Louisiana and has its principal place of business in the State of Louisiana. Plaintiff Storms is a citizen of the State of Louisiana because he resides in the State of Louisiana. In contrast, none of the Defendants are citizens of the State of Louisiana. Defendant Lancium is a citizen of the States of Delaware and Texas because it is organized under the laws of the State of Delaware and has its principal place of business in the State of Texas. Defendant McNamara is a citizen of the State of California because he resides in the State of California. Defendant Cline is a citizen of the State of Texas because he resides in the State of Texas. Therefore, because the Plaintiffs are both citizens of the State of Louisiana (and no other states) for purposes of diversity jurisdiction, and none of the Defendants are citizens of the State of Louisiana, complete diversity exists among the parties.

~~16.~~15. This Court has general personal jurisdiction over Lancium because it is organized under the laws of the State of Delaware and because it maintains an ongoing presence in this District at least through its registered agent.

~~17.~~16. This Court has specific personal jurisdiction over each of Defendants McNamara and Cline at least under Title 6 of the Delaware Code, § 18-109(a).

~~18.~~17. On information and belief, Defendant McNamara is the Chief Executive Officer of Lancium. On information and belief, as the Chief Executive Offer, McNamara participates

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materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

~~19.~~18. McNamara is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from the interests of Lancium and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claims against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant McNamara together. Plaintiffs' claims against Defendant McNamara arise out of his exercise of his powers as Chief Executive Officer of Lancium.

~~20.~~19. On information and belief, Defendant Cline is the Chief Computing Officer of Lancium. On information and belief, as the Chief Computing Officer, Cline participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

~~21.~~20. Cline is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from Lancium's interest and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claim against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant Cline together. Plaintiffs' claims against Defendant Cline arise out of his exercise of his powers as Chief Computing Officer of Lancium.

~~22.~~21. The actions of Defendants McNamara and Cline establish sufficient minimum contacts with Delaware under Delaware law and the United States Constitution to give this Court personal jurisdiction over each of them.

~~23.~~22. As described below, each Defendant has committed acts giving rise to this action.

VENUE

~~24.~~23. Venue is proper in this District under 28 U.S.C. § 1391(b)(3) because there is no district in which an action may otherwise be brought as provided in § 1391(b) and Defendant Lancium is subject to the Court's personal jurisdiction with respect to this action.

PLAINTIFFS' PROPRIETARY CRYPTOCURRENCY MINING TECHNOLOGY

~~25.~~24. As of 2018, the amount of energy required to process computer algorithms to mine cryptocurrencies like Bitcoin was three times greater than the energy required to physically mine gold. Conventional mining of "copper, gold, platinum, and rare earth oxides are 4, 5, 7, and 9 megajoules to generate one U.S. dollars," while "it costs an average of 17 megajoules to mine $1 worth of bitcoin."[1] The large amount of energy required to mine cryptocurrencies can make such mining financially prohibitive, and even when financially lucrative, the large energy requirements make cryptocurrency mining harmful to the global environment, with studies showing carbon dioxide emissions from cryptocurrency mining "single-handedly rais[ing] global temperatures by 2 degrees by 2023." *Id.*

~~26.~~25. At the same time, some forms of electrical power generation are terribly inefficient. When producers of electrical power are unable to quickly adjust their operations in response to dynamically changing grid conditions, these producers frequently sell power at low or even negative prices until demand and market prices increase.

~~27.~~26. Because cryptocurrency mining is a computationally demanding process, it requires significant energy. As a result, industrial-scale cryptocurrency mining places a large

[1] https://www.marketwatch.com/story/mining-bitcoin-is-3-times-more-expensive-than-mining-gold-research-paper-finds-2018-11-06

energy burden on the power grid, driving demand and costs as well as increasing the likelihood of grid component failure.

~~28.~~27. In late 2018 and early 2019, Austin Storms sought to address these problems by developing energy-efficient cryptocurrency mining systems and methods that reduce the environmental impact of energy-intensive mining operations. Storms conceived of a system that better uses available energy resources to increase the stability of the energy grid, minimize a mining operation's impact on peak-demand, and alleviate ~~electricity undersupply and/or oversupply~~energy over supply conditions, all while decreasing the overall energy costs of the mining operation and increasing its profitability.

~~29.~~28. Austin Storms conceived of and developed the BearBox Technology. Storms is the president and founder of BearBox. The BearBox Technology includes hardware and software components. Structurally, the BearBox Technology includes a housing for a plurality of miners (such as ASICs, graphics cards, or the like) under the direction of a smart controller(s).

~~30.~~29. The smart controller monitors various external factors, such as current and expected energy demand and pricing information, current and expected cryptocurrency pricing, and the like. Based on these external factors, the system may determine whether conditions are appropriate to mine cryptocurrency and, if so, subsequently mines the cryptocurrency. Optionally, the system also includes other components for cooling, air-filtration, and related features.

~~31.~~30. In the BearBox Technology, a controller (such as a power distribution unit, network interface, or the like) monitors various external factors, such as current and expected energy demand/pricing information, current and expected cryptocurrency pricing, and the like. Based on these external factors, the controller(s) determines appropriate times to mine

cryptocurrency in accordance with a desired performance strategy (for example, profitability thresholds). At the appropriate times, the controller initiates mining, for example, by powering on the miners.

DEFENDANTS WRONGFULLY CLAIM THE BEARBOX TECHNOLOGY AS THEIR OWN

~~32.~~31. In May 2019, Storms attended the Fidelity FCAT Mining Summit in Boston, Massachusetts on behalf of BearBox to promote the BearBox Technology and seek potential customers for his revolutionary system.

~~33.~~32. While at the conference, Storms met Defendant McNamara. Defendant McNamara showed immediate interest in the BearBox Technology. Under the rouse of a potential business relationship, McNamara pumped Storms for details about the BearBox Technology over the course of several exchanges, which included conversations, emails, and text messages about the BearBox Technology. Storms took McNamara to dinner where McNamara continued to pump Storms for details about the BearBox Technology. At all times before and during Storms's disclosure of this information, Storms told McNamara that the BearBox Technology was confidential, and Storms relied on McNamara's good faith assurances that he would keep confidential the information he received from Storms about the BearBox Technology.

~~34.~~33. Following the conference, McNamara continued to press Storms for additional details about the BearBox Technology via text messaging and email. Again relying on Defendant McNamara's assurances of confidentiality, Storms provided annotated system diagrams, component specifications, and modeled data sets to mimic real-world Bitcoin and energy prices. Storms included express confidentiality notices in his communications with Defendant McNamara.

~~35.~~34. After Storms disclosed the BearBox Technology to McNamara, McNamara abruptly ended all communications with Storms.

~~36.~~35. Storms last communicated with McNamara on May 9, 2019 via e-mail, and after sending that message, Storms did not hear from McNamara again.

~~37.~~36. At that time, Storms understood that McNamara was not interested in investing in the BearBox Technology. He had no reason to suspect that McNamara would steal the BearBox Technology and claim it as his own.

~~38.~~37. On information and belief, Defendants filed U.S. provisional patent application No. 62/927,119 on October 28, 2019, naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

~~39.~~38. In addition to falsely claiming to be the inventors of the inventions disclosed in the application, Defendants wrongfully disclosed, without authorization, the confidential BearBox Technology to the United States Patent and Trademark Office.

~~40.~~39. Likewise, on December 4, 2019, Defendants filed U.S. Patent Application Serial No. 16/702,931, once again naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

~~41.~~40. The ’433 Patent issued on March 31, 2020 naming Defendants McNamara and Cline as the sole purported inventors on the face of the patent. A true and correct copy of the ’433 Patent is attached hereto as Exhibit A.

~~42.~~41. The inventions claimed in the ’433 patent ~~encompass~~fall within the scope of the BearBox Technology, yet Defendants falsely identified themselves as the inventors of the claimed inventions, when, in fact, Storms is the sole inventor of the claimed inventions.

~~43.~~42. On information and belief, McNamara and Cline assigned their purported rights in the ’433 patent to Lancium. On information and belief, at all times, Lancium was aware that McNamara and Cline, both officers of Lancium, were not the rightful inventors of the BearBox Technology disclosed in the patent and the inventions claimed in the patent.

~~44.~~43. Defendants McNamara and Cline each submitted signed declarations falsely swearing that they were “an original joint inventor” of the claimed subject matter. A true and correct copy of Defendant McNamara’s and Defendant Cline’s declarations are attached as Exhibit B.

~~45.~~44. On August 14, 2020, Lancium filed a lawsuit in the U.S. District Court for the Western District of Texas against Layer1 Technologies, Inc. (“Layer1”) asserting that Layer1 infringes the ’433 patent. That case is captioned *Lancium LLC v. Layer1 Technologies, Inc.*, Case No. 6:20-cv-739 (W.D. Texas) (the “Layer1 Lawsuit”).

~~46.~~45. As part of the Layer1 Lawsuit, Defendants falsely asserted that McNamara and Cline are the sole inventors of the inventions claimed in the ’433 patent.

~~47.~~46. Plaintiffs became aware of Defendants’ wrongful use of the BearBox Technology on or about August 17, 2020, when they learned about the Layer1 Lawsuit through a press release dated August 14, 2020, posted by Lancium on PRNewswire. That press release is available at the following URL: https://www.prnewswire.com/news-releases/controllable-load-resource-clr-market-leader-lancium-files-patent-infringement-lawsuit-against-layer1-301112687.html.

~~48.~~47. Before seeing the August 14, 2020 press release, Plaintiffs were unaware of Defendants’ wrongful use of the BearBox Technology and was unaware of the ’433 patent.

~~49.~~48. On March 5, 2021, Lancium and Layer1 entered a Stipulation to Dismiss with Prejudice in the Layer1 Lawsuit. According to the stipulation, the parties had entered a Settlement Agreement to resolve the Layer1 Lawsuit.

~~50.~~49. According to a press release issued by Lancium on March 8, 2021, Lancium and Layer 1 "have entered into a mutually beneficial partnership. Layer1 has licensed Lancium's intellectual property and Lancium will provide Smart Response™ software and services to Layer1." The press release is available at the following URL: https://www.prnewswire.com/news-releases/lancium-and-layer1-settle-patent-infringement-suit-301242602.html

~~51.~~50. On information and belief, as part of the Settlement Agreement between Lancium and Layer1 to settle the Layer1 Lawsuit, Lancium received and continues to receive valuable consideration from Layer1, all of which rightly belongs to Plaintiffs, the rightful owners of the inventions claimed in the '433 Patent.

COUNT I
CORRECTION OF INVENTORSHIP FOR THE '433 PATENT: AUSTIN STORMS AS SOLE INVENTOR

~~52.~~51. Plaintiffs incorporate the above paragraphs by reference.

~~53.~~52. Storms is the sole inventor of the subject matter claimed in the '433 Patent.

~~54.~~53. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the '433 patent and the currently listed inventors on the '433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms or BearBox.

~~55.~~54. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the '433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT II
IN THE ALTERNATIVE, CORRECTION OF INVENTORSHIP FOR THE '433 PATENT: AUSTIN STORMS AS JOINT INVENTOR WITH THE CURRENTLY NAMED INVENTORS

~~56.~~55. Plaintiffs incorporates the above paragraphs by reference.

~~57.~~56. In the alternative, Storms is a joint inventor of the subject matter claimed in the '433 Patent and should be added to the individuals currently named as inventors on the '433 Patent.

~~58.~~57. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the '433 patent and the currently listed inventors on the '433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms.

~~59.~~58. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the '433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT III
CONVERSION BY LANCIUM, MCNAMARA, AND CLINE

~~60.~~59. Plaintiffs incorporates the above paragraphs by reference.

~~61.~~60. Austin Storms, in his capacity as founder and President of BearBox, conceived, developed, and reduced to practice the BearBox Technology. Plaintiffs own the BearBox Technology, related know-how, and related intellectual property. Plaintiffs owned this property during all relevant time periods in this suit. Information on the BearBox Technology was provided to Defendants solely for the purposes of evaluation for a potential business relationship and under strict confidentiality obligations.

~~62.~~61. Defendants assumed dominion and control over the BearBox Technology by claiming it as their own in the ’433 patent. Through their wrongful conduct in obtaining the ’433 Patent and claiming the BearBox Technology as their own, the Defendants have wrongfully obtained the purported ability to exclude Plaintiffs and others from using the BearBox Technology. This constitutes unauthorized and unlawful conversion by Defendants.

~~63.~~62. As a result of Defendants’ wrongful actions, Plaintiffs will suffer imminent and irreparable damages in an amount to be proven at trial. In particular, Plaintiffs have been damaged by losing valuable intellectual property from which Plaintiffs would have derived substantial revenue via licensing and/or selling patented products.

COUNT IV
UNJUST ENRICHMENT BY LANCIUM, MCNAMARA, AND CLINE

~~64.~~63. Plaintiffs incorporate the above paragraphs by reference.

~~65.~~64. Plaintiffs conferred a benefit on Defendants by providing them valuable intellectual property about cryptocurrency mining systems and related confidential information and materials under the boundaries of a potential collaboration between BearBox and Lancium.

~~66.~~65. Defendants accepted that cryptocurrency mining intellectual property and, indeed, continuously asked Storms to provide more information and materials, having recognized the benefit that Defendants received by having access to the BearBox Technology.

~~67.~~66. Defendants accepted and retained the BearBox Technology, and used it to their own advantage, at Plaintiffs’ expense.

~~68.~~67. Defendants have been and continue to be unjustly enriched by profiting from their wrongful conduct. In particular, Defendants have unlawfully used Plaintiffs’ property by asserting inventorship over the BearBox Technology, and deriving an unjust benefit from

exploiting Storms's cryptocurrency mining inventions. It would be inequitable for Defendants to retain these benefits under these circumstances.

~~69.~~68. Plaintiffs have incurred, and continue to incur, detriment in the form of loss of money and property as a result of Defendants' wrongful use of Plaintiffs' intellectual property, including the right to any patent based on their own intellectual property~~ and any royalties derived from that intellectual property.~~. The intellectual property, including the right to any patents based on Plaintiffs' intellectual property and to any patent documents (including assignment documents), U.S. and foreign, are unique and there is no adequate remedy at law.

~~70.~~69. The harm to Plaintiffs is continuous, substantial, and irreparable.

~~COUNT V~~
~~TRADE SECRET MISAPPROPRIATION UNDER~~
~~FEDERAL DEFEND TRADE SECRETS ACT, 18 U.S.C. § 1836~~

~~71. Plaintiffs incorporate the above paragraphs by reference.~~

~~72. At all relevant times, Plaintiffs and Defendants were engaged in interstate commerce. For example, Plaintiffs and Defendants are engaged in trade and business, developing and testing, among other things, cryptocurrency mining systems and related methods in interstate commerce throughout the United States.~~

~~73. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about the BearBox Technology relating to cryptocurrency mining systems and related methods from Plaintiff. The confidential information included detailed technical information about the BearBox Technology. Such information constitutes trade secrets of substantial economic value. This confidential technical information was not known to the public or to other persons who can obtain economic value from its~~

~~disclosure or use. This information constituted a trade secret under the Defend Trade Secrets Act, 18 U.S.C. §§ 1836.~~

~~74. Defendants knew the technical information they received from Austin Storms about the BearBox Technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, for internal use only, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship. Plaintiffs took reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of collaborators that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its offices and computers.~~

~~75. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent constituted a misappropriation of Plaintiffs' trade secrets. Defendants acquired the confidential information under circumstances giving rise to a duty to maintain the secrecy of the trade secret or limit the use of the trade secret.~~

~~76. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent was an unauthorized disclosure in breach of Defendants' agreement to maintain the secrecy of this information or otherwise limit its use. As recently as December 4, 2019, Defendants have wrongly sworn that Plaintiffs' confidential technical information is their own by declaring to the United States Patent and Trademark Office that they were the original and joint inventors of the inventions claimed in the '433 patent. Even ignoring that Defendants have improperly claimed this information as their own, through their public filings Defendants have disclosed the confidential technical information without the express or implied consent of~~

~~Plaintiffs. The acts of taking Plaintiffs' confidential information, claiming it as Defendants' own, and submitting it in public filings were improper means in breach of a confidential relationship. Further, Defendant McNamara agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.~~

~~77. As a result of Defendants' misappropriation of Plaintiffs' trade secrets, Plaintiffs' have suffered and will suffer damages in an amount to be proven at trial including, but not limited to, damages for actual loss caused by the misappropriation of the trade secrets, damages for any unjust enrichment caused by the misappropriation of the trade secrets, and/or damages caused by the misappropriation measured by imposition of liability for a reasonable royalty for the Defendants' unauthorized disclosure or use of the trade secrets.~~

~~78. The Defendants willfully and maliciously misappropriated the Plaintiffs' trade secrets, and Plaintiffs are therefore entitled to an award of exemplary damages and an award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(C), (D).~~

~~COUNT VI~~
~~TRADE SECRET MISAPPROPRIATION UNDER~~
~~TEXAS CIVIL PRACTICE AND REMEDIES CODE § 134A~~

~~79. Plaintiffs incorporate the above paragraphs by reference.~~

~~80. At all relevant times, Plaintiffs and Defendants were engaged in trade or commerce within the meaning of Texas Civil Practice and Remedies c. § 134A, the Texas Uniform Trade Secrets Act. For example, Plaintiffs and Defendants are engaged in trade and business, developing and testing, among other things, cryptocurrency mining systems and related methods.~~

~~81. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about the BearBox Technology relating to cryptocurrency mining systems and related methods from Plaintiff. The confidential information included detailed technical information about the BearBox Technology. Such information constitutes trade secrets of substantial economic value. This confidential technical information was not known to the public or to other persons who can obtain economic value from its disclosure or use. This information constituted a trade secret.~~

~~82. Defendants knew the technical information they received from Austin Storms about the BearBox Technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, for internal use only, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship. Plaintiffs took reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of collaborators that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its offices and computers.~~

~~83. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent constituted a misappropriation of Plaintiffs' trade secrets. Defendants acquired the confidential information under circumstances giving rise to a duty to maintain the secrecy of the trade secret or limit the use of the trade secret.~~

~~84. Defendants' inclusion of Plaintiffs' confidential technical information in the '433 patent was an unauthorized disclosure in breach of Defendants' agreement to maintain the secrecy of this information or otherwise limit its use. As recently as December 4, 2019,~~

~~Defendants have wrongly sworn that Plaintiffs' confidential technical information is their own by declaring to the United States Patent and Trademark Office that they were the original and joint inventors of the inventions claimed in the '433 patent. Even ignoring that Defendants have improperly claimed this information as their own, through their public filings Defendants have disclosed the confidential technical information without the express or implied consent of Plaintiffs. The acts of taking Plaintiffs' confidential information, claiming it as Defendants' own, and submitting it in public filings were improper means in breach of a confidential relationship. Further, Defendant McNamara agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.~~

~~85. As a result of the misappropriation of Plaintiffs' trade secrets and intended immediate use by the Defendants, Plaintiffs' have suffered and will suffer damages in an amount to be proven at trial.~~

~~COUNT VII~~COUNT V
NEGLIGENT MISREPRESENTATION BY LANCIUM AND MCNAMARA

~~86.~~70. Plaintiffs incorporate the above paragraphs by reference.

~~87.~~71. In connection with the potential work involving cryptocurrency mining systems and related methods, Storms told Defendant McNamara that the cryptocurrency mining systems and related methods were proprietary to Plaintiffs and not to be used or shared outside of Lancium. Defendant McNamara gave his word that he would abide by this confidentiality. On information and belief, Defendant McNamara agreed to keep the BearBox Technology confidential despite later recklessly incorporating the BearBox Technology into his own patent applications and swearing, as recently as December 4, 2019, that he is an inventor of the

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BearBox Technology. Storms relied on Defendant McNamara's assurances of confidentiality and continued to share details about the BearBox Technology with Defendants.

~~88.~~72. If Plaintiffs had known that Defendants would secretly incorporate the BearBox Technology into Defendants' own patent applications to claim them as Defendants' intellectual property, Plaintiffs would not have continued working with and sharing intellectual property with Defendants.

~~89.~~73. Plaintiffs suffered a pecuniary loss based on this reliance including the loss of potential patent rights, and the costs of Plaintiffs' know-how converted under the guise of a potential business relationship.

JURY DEMAND

~~90.~~74. Under Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiffs respectfully demand a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, BearBox respectfully requests the following relief:

A. An order that the Director of the United States Patent and Trademark Office correct the inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

B. Alternatively, an order that Defendants sign the requisite documents to correct inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

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C. A declaration that Austin Storms is the sole inventor, or, in the alternative, is a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

D. A preliminary and a permanent injunction enjoining Defendants Lancium, McNamara, and Cline from asserting that McNamara or Cline are inventors of the '433 Patent in violation of the United States federal patent laws;

E. An order that Defendants immediately transfer to Plaintiffs all right, title, and interest in all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of Plaintiffs' intellectual property;

F. An order for a constructive trust over all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of Plaintiffs' intellectual property;

G. Financial relief including damages, consequential damages, disgorgement of Defendants' ill-gotten profits, Defendants' unjust enrichment~~, restitution~~, reasonable royalty damages, lost profits damages, reliance damages, and/or all other appropriate financial relief, all in an amount to be determined at trial, with interest;

H. An award of the amount by which Defendants have been unjustly enriched by their actions set forth in this Complaint and their purported ownership of patents covering Plaintiffs' intellectual property;

~~I. An award of exemplary, enhanced, and/or punitive damages as permitted by law, including under 18 U.S.C. § 1836(b)(3)(C) and Texas Business and Commerce Code § 17E;~~

~~J.~~I. A finding that this is an exceptional case warranting imposition of attorney fees against Defendants and an award to Plaintiffs of its reasonable costs and attorney fees incurred in bringing this action pursuant to 35 U.S.C. § 285; and

~~K. An award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(D); and~~

~~L.~~J. An award of such further relief at law or in equity, such as preliminary and/or permanent injunctive relief, as the Court deems just and proper.

ASHBY & GEDDES

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Dated: May 24, 2021

LANCIUM IS THE TRUE INNOVATOR IN THIS FIELD

20. Lancium is a technology company creating software and intellectual property solutions that enable more renewable energy on the nation's power grid. Lancium's products include Lancium Smart Response™ for rapid server power management, and Lancium Compute™, a platform for high throughput computing applications. Lancium's solutions help ensure that renewable energy can power our future.

21. Lancium is the leader in data center power ramping software.

22. As data center power demand continues to escalate, Lancium Smart Response™ software can unlock huge power costs savings for data center owners. The software also provides critical services to the power grid ensuring reliability and resiliency. As every grid takes on more renewable energy, the power market will need much greater quantities of flexible load, and in particular, Controllable Loads enabled by Lancium Smart Response™. Lancium Smart Response™ functionality enables data centers to provide this crucial service.

23. Lancium has numerous issued and pending patents.

24. Lancium's issued patents include the following:

- U.S. Patent No. 10,873,211 (filed Sept. 13. 2018) "Systems and Methods for Dynamic Power Routing with Behind-the-Meter Energy Storage"
- U.S. Patent No. 10,444,818 (filed Oct. 30, 2018) "Methods and Systems for Distributed Power Control of Flexible Datacenters"
- U.S. Patent No. 10,367,353 (filed Oct. 30, 2018) "Managing Queue Distribution between Critical Datacenter and Flexible Datacenter"
- U.S. Patent No. 10,452,127 (filed Jan. 11, 2019) "Redundant Flexible Datacenter Workload Scheduling"
- U.S. Patent No. 10,618,427 (filed Oct. 8, 2019) "Behind-the-Meter Branch Loads for Electrical Vehicle Charging
- U.S. Patent No. 10,608,433 (filed Dec. 4, 2019) "Methods and Systems for Adjusting Power Consumption Based on a Fixed-Duration Power Option

Agreement"

- U.S. Patent No. 10,857,899 (filed Mar. 4, 2020) "Behind-the-Meter Branch Loads for Electrical Vehicle Charging"

25. One of Lancium's patent applications, International Application Number PCT/US2018/0 17950, was filed on February 13, 2018 and published as the '632 application on July 18, 2019.

26. The '632 application describes a method and system for dynamic power delivery to a flexible datacenter using unutilized energy sources. In one embodiment of the invention:

> a method and system for dynamic power delivery' to a flexible datacenter uses unutilized behind-the-meter power sources without transmission and distribution costs. The flexible datacenter may be configured to modulate power delivery to one or more computing systems based on the availability of unutilized behind-the-meter power or an operational directive. For example, the flexible datacenter may ramp-up to a fully online status, ramp-down to a fully offline status, or dynamically reduce power consumption, act a load balancer, or adjust the power factor. Advantageously, the flexible datacenter may perform computational operations, such as blockchain hashing operations, with little to no energy costs, using clean and renewable energy that would otherwise be wasted.

See '632 application ¶ [0022].

27. Put simply, and as discussed more thoroughly below, the '632 application describes the so-called "BearBox technology."

28. The '632 application claims priority to U.S. Provisional Application No. 62/616,348 (the "'348 Provisional"), filed on Jan. 11, 2018.

29. The '632 application lists the following Lancium current or former personnel as inventors: David Henson, Michael McNamara, and Raymond Cline.

30. The '632 application lists the "Applicant" as Lancium LLC.

31. On information and belief, BearBox LLC knew of the '632 application before filing the Complaint in this action.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR., Defendants.	)	C.A. No. 21-534-MN

SCHEDULING ORDER

This 6th day of July 2021, ~~the Court having conducted an initial Rule 16(b) scheduling conference pursuant to Local Rule 16.1(b), and~~ MN the parties having determined after discussion that the matter cannot be resolved at this juncture by settlement, voluntary mediation, or binding arbitration;

IT IS ORDERED that:

1. Rule 26(a)(1) Initial Disclosures and E-Discovery Default Standard.

Unless otherwise agreed to by the parties, the parties shall make their initial disclosures pursuant to Federal Rule of Civil Procedure 26(a)(1) within five (5) days of the date the Court entered this Order. If they have not already done so, the parties are to review the Court's Default Standard for Discovery, Including Discovery of Electronically Stored Information ("ESI"), which is posted at http://www.ded.uscourts.gov (*see* Other Resources, Default Standard for Discovery) and is incorporated herein by reference.

2. Joinder of Other Parties and Amendment of Pleadings. All motions to join other parties, and to amend or supplement the pleadings, shall be filed on or before **November 1, 2021**.

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Unless otherwise ordered by the Court, any motion to join a party or motion to amend the pleadings shall be made pursuant to the procedures set forth in Paragraphs 7(g) and 8.

3. Application to Court for Protective Order. Should counsel find it will be necessary to apply to the Court for a protective order specifying terms and conditions for the disclosure of confidential information, counsel should confer and attempt to reach an agreement on a proposed form of order and submit it to the Court within ten (10) days from the date the Court enters this Order. Should counsel be unable to reach an agreement on a proposed form of order, counsel must follow the provisions of Paragraph 7(g) below.

Any proposed protective order must include the following paragraph:

> Other Proceedings. By entering this order and limiting the disclosure of information in this case, the Court does not intend to preclude another court from finding that information may be relevant and subject to disclosure in another case. Any person or party subject to this order who becomes subject to a motion to disclose another party's information designated "confidential" [the parties should list any other level of designation, such as "highly confidential," which may be provided for in the protective order] pursuant to this order shall promptly notify that party of the motion so that the party may have an opportunity to appear and be heard on whether that information should be disclosed.

4. Papers Filed Under Seal. In accordance with section G of the Revised Administrative Procedures Governing Filing and Service by Electronic Means, a redacted version of any sealed document shall be filed electronically within seven (7) days of the filing of the sealed document.

5. Courtesy Copies. The parties shall provide to the Court two (2) courtesy copies of all briefs and any other document filed in support of any briefs (*i.e.*, appendices, exhibits, declarations, affidavits etc.). This provision also applies to papers filed under seal. All courtesy copies shall be double-sided.

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6. ADR Process. This matter is referred to a magistrate judge to explore the possibility of alternative dispute resolution.

7. Discovery. Unless otherwise ordered by the Court or agreed to by parties, the limitations on discovery set forth in the Federal Rules shall be strictly observed.

(a) Fact Discovery Cut Off. All fact discovery in this case shall be initiated so that it will be completed on or before December 14, 2021.

(b) Document Production. Document production shall be substantially complete by October 8, 2021.

(c) Requests for Admission. A maximum of fifty (50) requests for admission are permitted for each side. For clarity, this limit does not apply to requests for admission related solely to authenticity.

(d) Interrogatories.

i. A maximum of twenty-five (25) interrogatories, including contention interrogatories, are permitted for each side.

ii. The Court encourages the parties to serve and respond to contention interrogatories early in the case. In the absence of agreement among the parties, contention interrogatories, if filed, shall first be addressed by the party with the burden of proof. The adequacy of all interrogatory answers shall be judged by the level of detail each party provides (*i.e.*, the more detail a party provides, the more detail a party shall receive).

(e) Depositions.

i. Limitation on Hours for Deposition Discovery. Each side is limited to a total of thirty (30) hours of taking testimony by deposition upon oral examination.

ii. Location of Depositions. Any party or representative (officer, director, or managing agent) of a party filing a civil action in this district court must ordinarily be required, upon request, to submit to a deposition at a place designated within this district. Exceptions to this general rule may be made by order of the Court. A defendant who becomes a counterclaimant, cross-claimant, or third-party plaintiff shall be considered as having filed an action in this Court for the purpose of this provision.

(f) Disclosure of Expert Testimony.

i. Expert Reports. For the party who has the initial burden of proof on the subject matter, the initial Federal Rule of Civil Procedure 26(a)(2) disclosure of expert testimony is due on or before January 18, 2022. The supplemental disclosure to contradict or rebut evidence on the same matter identified by another party is due on or before February 18, 2022. Reply expert reports from the party with the initial burden of proof are due on or before March 8, 2022. No other expert reports will be permitted without either the consent of all parties or leave of the Court. Along with the submissions of the expert reports, the parties shall advise of the dates and times of their experts' availability for deposition.

ii. Objections to Expert Testimony. To the extent any objection to expert testimony is made pursuant to the principles announced in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), as incorporated in Federal Rule of Evidence 702, it shall be made by motion no later than the deadline for dispositive motions set forth herein, unless otherwise ordered by the Court.

iii. Expert Discovery Cut Off. All expert discovery in this case shall be initiated so that it will be completed on or before April 13, 2022.

(g) Discovery Matters and Disputes Relating to Protective Orders.

i. Any discovery motion filed without first complying with the following procedures will be denied without prejudice to renew pursuant to these procedures.

ii. Should counsel find, after a reasonable effort pursuant to Local Rule 7.1.1 that they are unable to resolve a discovery matter or a dispute relating to a protective order, the parties involved in the discovery matter or protective order dispute shall contact the Court's Judicial Administrator to schedule an argument.

iii. On a date to be set by separate order, generally not less than four (4) days prior to the conference, the party seeking relief shall file with the Court a letter, not to exceed three (3) pages, outlining the issues in dispute and its position on those issues. On a date to be set by separate order, but generally not less than three (3) days prior to the conference, any party opposing the application for relief may file a letter, not to exceed three (3) pages, outlining that party's reasons for its opposition.

iv. The parties shall provide to the Court two (2) courtesy copies of its discovery letter and any other document filed in support of any letter (*i.e.*, appendices, exhibits, declarations, affidavits etc.). This provision also applies to papers filed under seal. All courtesy copies shall be double-sided.

v. Should the Court find further briefing necessary upon conclusion of the conference, the Court will order it. Alternatively, the Court may choose to resolve the dispute prior to the conference and will, in that event, cancel the conference.

8. Claim Construction. The parties have determined that claim construction may be necessary in this case. By August 27, 2021, the parties shall determine whether or not claim construction is necessary and further notify the Court of their decision, and if claim construction is necessary, the parties will propose a claim construction schedule for the Court's consideration.

9. Motions to Amend / Motions to Strike.

(a) Any motion to amend (including a motion for leave to amend) a pleading or any motion to strike any pleading or other document shall be made pursuant to the discovery dispute procedure set forth in Paragraph 7(g) above.

(b) Any such motion shall attach the proposed amended pleading as well as a "redline" comparison to the prior pleading or attach the document to be stricken.

10. Case Dispositive Motions.

(a) All case dispositive motions, an opening brief, and affidavits, if any, in support of the motion shall be served and filed on or before June 13, 2022. Briefing will be presented pursuant to the Court's Local Rules. No case dispositive motion under Rule 56 may be filed more than ten (10) days before the above date without leave of the Court.

(b) Concise Statement of Facts Requirement. Any motion for summary judgment shall be accompanied by a separate concise statement, not to exceed six (6) pages, which details each material fact which the moving party contends is essential for the Court's resolution of the summary judgment motion (not the entire case) and as to which the moving party contends there is no genuine issue to be tried. Each fact shall be set forth in a separate numbered paragraph and shall be supported by specific citation(s) to the record.

Any party opposing the motion shall include with its opposing papers a response to the moving party's concise statement, not to exceed six (6) pages, which admits or disputes the facts set forth in the moving party's concise statement on a paragraph-by-paragraph basis. To the extent a fact is disputed, the basis of the dispute shall be supported by specific citation(s) to the record. Failure to respond to a fact presented in the moving party's concise statement of facts shall indicate that fact is not in dispute for purposes of summary judgment. The party opposing the

motion may also include with its opposing papers a separate concise statement, not to exceed four (4) pages, which sets forth material facts as to which the opposing party contends there is a genuine issue to be tried. Each fact asserted by the opposing party shall also be set forth in a separate numbered paragraph and shall be supported by specific citation(s) to the record.

The moving party shall include with its reply papers a response to the opposing party's concise statement of facts, not to exceed four (4) pages, on a paragraph-by-paragraph basis. Failure to respond to a fact presented in the opposing party's concise statement of facts shall indicate that fact remains in dispute for purposes of summary judgment.

11. Applications by Motion. Except as otherwise specified herein, any application to the Court shall be by written motion. Any non-dispositive motion should contain the statement required by Local Rule 7.1.1.

12. Motions *in Limine.* Motions *in limine* shall not be separately filed. All *in limine* requests and responses thereto shall be set forth in the proposed pretrial order. Each party shall be limited to three (3) *in limine* requests, unless otherwise permitted by the Court. The *in limine* request and any response shall contain the authorities relied upon; each *in limine* request may be supported by a maximum of three (3) pages of argument, may be opposed by a maximum of three (3) pages of argument, and the party making the *in limine* request may add a maximum of one (1) additional page in reply in support of its request. If more than one party is supporting or opposing an *in limine* request, such support or opposition shall be combined in a single three (3) page submission (and, if the moving party, a single one (1) page reply), unless otherwise ordered by the Court. No separate briefing shall be submitted on *in limine* requests, unless otherwise permitted by the Court.

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13. Pretrial Conference. On **November 22, 2022**, the Court will hold a pretrial conference in Court with counsel beginning at **4:30 p.m**. The parties shall file with the Court the joint proposed final pretrial order in compliance with Local Rule 16.3(c) and the Court's Preferences and Procedures for Civil Cases not later than seven (7) days before the pretrial conference. Unless otherwise ordered by the Court, the parties shall comply with the timeframes set forth in Local Rule 16.3(d)(1)-(3) for the preparation of the joint proposed final pretrial order. The Court will advise the parties at or before the above-scheduled pretrial conference whether an additional pretrial conference will be necessary.

The parties shall provide the Court two (2) double-sided courtesy copies of the joint proposed final pretrial order and all attachments. The proposed final pretrial order shall contain a table of contents and the paragraphs shall be numbered.

14. Jury Instructions, Voir Dire, and Special Verdict Forms. Where a case is to be tried to a jury, pursuant to Local Rules 47.1(a)(2) and 51.1 the parties should file (i) proposed voir dire, (ii) preliminary jury instructions, (iii) final jury instructions, and (iv) special verdict forms seven (7) full business days before the final pretrial conference. This submission shall be accompanied by a courtesy copy containing electronic files of these documents, in Microsoft Word format, which may be submitted by e-mail to mn_civil@ded.uscourts.gov.

15. Trial. This matter is scheduled for a four (4) day jury trial beginning at 9:30 a.m. on **December 5, 2022**, with the subsequent trial days beginning at 9:00 a.m. Until the case is submitted to the jury for deliberations, the jury will be excused each day at 4:30 p.m. The trial will be timed, as counsel will be allocated a total number of hours in which to present their respective cases.

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Maryellen Noreika

The Honorable Maryellen Noreika
United State District Judge

EXHIBIT A

EVENT	DEADLINE
Submission of Joint Scheduling Order	June 24, 2021
Rule 26(a)(1) Initial Disclosures	Within 5 days of the date of the Scheduling Order
Application to Court for Protective Order	Within 10 days of the date of the Scheduling Order
Determination of Whether Claim Construction is Necessary and Advise Court	August 27, 2021
Substantial Completion of Document Production	October 8, 2021
Fact Discovery Cut-Off	December 14, 2021
Initial Expert Reports	January 18, 2022
Rebuttal Expert Reports	February 22, 2022
Reply Expert Reports	March 8, 2022
Expert Discovery Cut-Off	April 13, 2022
Case Dispositive Motions	June 13, 2022
Pretrial Conference	November 22, 2022 at 4:30 p.m.
Trial (4-day jury)	December 5, 2022

favorable to Plaintiffs, Plaintiffs have pled valid facts to support a finding that Defendants owed Plaintiffs a duty and Defendants' motion must be denied.

C. Material factual disputes preclude judgment on the pleadings

Defendants' Motion for Judgment on the Pleadings should be denied because several material issues of fact exist that, at a minimum, prevent resolution of necessary issues at this time. Judgment on the pleadings is proper only if the "movant clearly establishes that no material issue of fact remains to be resolved." *Mid-Am. Salt, LLC v. Morris Cty. Coop. Pricing Council*, 964 F.3d 218, 226 (3d Cir. 2020). Yet Defendants do not even attempt to argue that there are no issues of material fact.

A cursory review of the pleadings show that this case is replete with material issues of fact that preclude judgment on the pleadings. "[D]efendants filed an answer, denied liability, and have asserted affirmative defenses. The defendants' denials are sufficient to place *all* material facts in this case in dispute and, therefore, serve as a bar to [defendants'] motion for judgment on the pleadings." *Rainier v. Rispoli*, 2012 WL 752371, at *2 (D. Del. 2012) (emphasis added). Defendants' answer here, particularly when viewed in favor of Plaintiffs, contain denials of liability and asserted affirmative defenses that place these material facts at issue in this case and thereby bar the instant motion. *See, e.g.*, Amended Answer to Amended Complaint, D.I. 30, ¶¶ 1, 3-4, 27-50; *Rainier*, 2012 WL 752371, at *2 (denying motion for judgment on the pleadings).

As an example, there are several material facts in dispute that are relevant to Plaintiffs' conversion claim in light of Defendants' Amended Answer. Under Louisiana law, "[t]o prevail on a claim of conversion, a plaintiff must prove that (1) he owned or had the right to possess; (2) the defendant's use was inconsistent with the plaintiff's right of ownership; and (3) the defendant's use constituted a wrongful taking." *Mabile v. BP, p.l.c.*, No. CV 11-1783, 2016 WL

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August 31, 2021

The Honorable Maryellen Noreika
United States District Court
844 N. King Street
Wilmington, DE 19801

VIA ELECTRONIC FILING

Re: *Bear Box LLC, et al. v. Lancium LLC, et al.,*
C.A. No. 21-534-MN

Dear Judge Noreika:

I write on behalf of the parties in connection with Paragraph 8 the Scheduling Order (D.I. 35) regarding the need for a claim construction hearing in this matter. Plaintiffs have not yet made a determination regarding a need for a claim construction hearing, but anticipate any request for a claim construction hearing will be made prior to October 15, 2021 in view of the current progress of fact discovery (including contention discovery).[1] Defendants do not believe claim construction will be needed, and Defendants oppose Plaintiffs' attempt to extend the deadline in Paragraph 8 of the Scheduling Order until October 15, 2021.

Should the Court have any questions, counsel are available at the Court's convenience.

Respectfully,

Andrew C. Mayo

Andrew C. Mayo (#5702)

ACM/nlm

cc: All Counsel of Record (via electronic mail)

[1] The parties are continuing to exchange contention discovery that Plaintiffs believe may bear on whether claim construction is needed. The Plaintiffs anticipate completing this contention discovery without the need for motion practice before Magistrate Judge Burke. Although Defendants declined to stipulate to extend this deadline, Plaintiffs will not burden the Court with a formal motion at this time. Instead, Plaintiffs will seek a claim construction hearing only if necessary after completing additional contention discovery.

{01718868;v1 }

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October 15, 2021

BY ECF
The Honorable U.S. Magistrate Judge Christopher J. Burke
U.S. District Court for the District of Delaware
J. Caleb Boggs Federal Building
844 N. King Street, Room 2325 – Unit 28
Wilmington, Delaware 19801

Re: ***BearBox LLC, et al. v. Lancium LLC, et al.,***
C.A. No. 21-534-MN-CJB

Dear Judge Burke:

Pursuant to Court's September 13, 2021 Oral Order (D.I. 59), I write to state that Defendants do not request claim construction at this time but reserve their right to later seek claim construction if Plaintiffs later seek claim construction, or based on information obtained during discovery.

Respectfully submitted,

Chad S.C. Stover (DE No. 4919)

cc: Andrew Colin Mayo (via ECF)
Benjamin T. Horton (via ECF)
Chelsea M. Murray (via ECF)
John R. Labbe (via ECF)
Raymond R. Ricordati, III (via ECF)

Courts have found that claims for conversion[4] that are dependent on a determination of patent inventorship are generally preempted by federal patent law. *See Gerawan Farming, Inc. v. Rehrig Pac. Co.*, No. 1:11-cv-01273-LJO BAM, 2012 WL 691758, at *7 (E.D. Cal. Mar. 2, 2012) (citing cases).[5] Defendants assert that Plaintiffs' conversion claim requires a determination of inventorship and is therefore preempted. (D.I. 33 at 7-9; D.I. 46 at 2) The Court agrees.

Plaintiffs' Amended Complaint begins by alleging that the case "is about the Defendants' *theft of inventions that rightfully belong to Plaintiffs*[,]" and Plaintiffs' conversion claim begins by incorporating by reference the allegations from Plaintiffs' correction of inventorship claims. (D.I. 19 at ¶¶ 1, 59 (emphasis added)) From there, the conversion claim alleges that "Defendants assumed dominion and control over the BearBox Technology *by claiming it as their own in the '433 patent*" and that "[t]hrough their wrongful conduct *in obtaining the '433 [p]atent and claiming the BearBox Technology as their own*, [] Defendants have wrongfully obtained the purported ability to exclude Plaintiffs and others from using the BearBox Technology." (*Id.* at ¶ 61 (emphasis added)) The harm that Plaintiffs allege as a result of the conversion is the loss of "valuable intellectual property[.]" (*Id.* at ¶ 62) This is clearly a claim that, by its wording, is

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4 At least for purposes of this Motion, both parties agree that Louisiana law applies to the state law claims at issue here. (D.I. 33 at 13; D.I. 42 at 10) Under Louisiana law, a claim for conversion requires proof of: (1) the plaintiff's right to possess; (2) that the defendant's use was inconsistent with the plaintiff's right of ownership; and (3) that the defendant's use constituted a wrongful taking. *Mabile v. BP, P.L.C.*, CIVIL ACTION NO. 11-1783, 2016 WL 5231839, at *21 (E.D. La. Sept. 22, 2016).

5 On the other hand, conversion claims that are based on a non-patent-ownership theory of conversion are generally not preempted by federal patent law. *Gerawan Farming, Inc.*, 2012 WL 691758, at *7.

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dependent on a determination of patent inventorship. It is thus preempted by federal patent law.[6] *See, e.g.*, *Speedfit LLC v. Woodway USA, Inc.*, 226 F. Supp. 3d 149, 160 (E.D.N.Y. 2016) (concluding that the plaintiffs' conversion claim was preempted by federal patent law, where plaintiffs' "assertion of ownership over the subject matter of the Woodway Patents, which underlies their claim of conversion, clearly turns on a determination of inventorship"); *Gerawan Farming, Inc.*, 2012 WL 691758, at *7 (concluding that the plaintiff's conversion claim was preempted by federal patent law, where the claim alleged that the defendant "substantially interfered with [the plaintiff's] rightful property by omitting [the plaintiff] as an inventor" and accordingly "wrongfully exercised control over [the plaintiff's] rights in the . . . '293 Patent") (internal quotation marks and citation omitted); *Gen. Elec. Co. v. Wilkins*, No. 1:10-cv-00674-OWW-JLT, 2011 WL 3163348, at *9 (E.D. Cal. July 26, 2011) (finding that the defendant's conversion claim was preempted, where it sought "compensation for [p]laintiff's purported interference with [d]efendant's inventorship interests in the intellectual property embodied in the '565 and '985 patents; in other words, [d]efendant seeks patent-like protection under the guise of the tort of conversion").[7]

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[6] In their briefing, Plaintiffs try to recast the conversion claim as one "based on acts of misappropriating documents and information[.]" (D.I. 42 at 7) But, as shown above, that is not accurate. The actual allegations in Count III make clear that Plaintiffs' conversion claim is "based on the alleged right to ownership of the '433 patent due to Storms' alleged inventorship." (D.I. 46 at 4)

[7] Moreover, the fact that Plaintiffs' conversion claim seeks damages amounting to the loss of "valuable intellectual property from which Plaintiffs would have derived substantial revenue via licensing and/or selling patented products[,]" (D.I. 19 at ¶ 62), demonstrates that it is patent-like in nature, *see Speedfit LLC*, 226 F. Supp. 3d at 160. That is another reason why the claim is preempted. (D.I. 46 at 4)

Because the Court finds that Plaintiffs' conversion claim is preempted, it need not now further evaluate Defendants' additional arguments for dismissal of the claim.

B. Unjust Enrichment (Count IV)

The next claim, in Count IV, is a claim for unjust enrichment.[8] As with conversion claims, unjust enrichment claims that are based on a determination of patent inventorship are generally preempted by federal patent law. *See, e.g.*, *Tavory v. NTP, Inc.*, 297 F. App'x 976, 983-84 (Fed. Cir. 2008) (finding that an unjust enrichment claim was preempted by federal patent law where the "dispositive issue [was plaintiff's] alleged co-inventorship"); *Heat Techs., Inc. v. Papierfabrik Aug. Koehler SE*, Civil Action No. 1:18-cv-01229-SDG, 2020 WL 12309512, at *4 (N.D. Ga. June 5, 2020) (citing cases); *James v. J2 Cloud Servs. Inc.*, Case No. 2:16-cv-05769-CAS(PJWx), 2018 WL 6092461, at *5 (C.D. Cal. Nov. 19, 2018).[9] Defendants

[8] The elements of an unjust enrichment claim in Louisiana are: (1) an enrichment of the defendant; (2) an impoverishment of the plaintiff; (3) a connection between the enrichment and the resulting impoverishment; (4) an absence of justification or cause for the enrichment and impoverishment; and (5) there must be no other remedy at law available to plaintiff. *Garber v. Badon & Ranier*, 981 So. 2d 92, 100 (La. Ct. App. 2008).

[9] On the other hand, there are some circumstances where federal courts have concluded that an unjust enrichment claim having some connection to patent rights was not preempted, such as where it was alleged that defendants wrongfully obtained a patent based on confidential information received from a plaintiff, and claimed ownership of it in violation of a contract. *See, e.g.*, *Spears v. SHK Consulting & Dev., Inc.*, 338 F. Supp. 3d 1272, 1277 (M.D. Fla. 2018); *see also Univ. of Colo. Found., Inc. v. Am. Cyanamid Co.*, 342 F.3d 1298, 1306-07 (Fed. Cir. 2003) (finding that an unjust enrichment claim was not preempted, where it amounted to "a legal claim to remedy the breach of a contract implied in law for disclosure of [plaintiffs'] confidential manuscript in exchange for a promise not to disseminate the idea without the [plaintiffs'] consent"); *cf. Ki Beom Kim v. Dyna Flex, Ltd.*, 525 F. Supp. 3d 999, 1007-08 (E.D. Mo. 2021) (denying a motion to remand, where plaintiff's unjust enrichment claim raises a substantial federal question regarding inventorship, as it was not "a *dispute strictly concerning ownership, typically involving an underlying contract*" but instead one where "Plaintiff is unquestionably arguing that he is the true inventor of the Invention and should have been included on the patents. If [Defendant] is the true inventor and owner of the patents, there is no reasonable claim that it has been unjustly enriched by continuing to sell products based on the Patents") (emphasis added).

assert that Plaintiffs' unjust enrichment claim, like its conversion claim, is focused on the question of inventorship (and necessarily requires a determination of inventorship in order to know whether a legal violation can be found). (D.I. 33 at 9-11; D.I. 46 at 2-3) The Court again agrees with Defendants.

Plaintiffs' unjust enrichment claim begins by incorporating the previous allegations of Plaintiffs' inventorship and conversion claims. (D.I. 19 at ¶ 63) It then alleges that "Plaintiffs conferred a benefit on Defendants by providing them *valuable intellectual property* about cryptocurrency mining systems and related confidential information and materials" and that "Defendants have been and continue to be unjustly enriched by profiting from their wrongful conduct[,] *[i]n particular, Defendants have unlawfully used Plaintiffs' property by asserting inventorship* over the BearBox Technology, and deriving an unjust benefit from exploiting Storms' cryptocurrency mining inventions." (*Id.* at ¶¶ 64, 67 (emphasis added)) As for damages, Plaintiffs allege a "loss of money and property as a result of Defendants' *wrongful use of Plaintiffs' intellectual property, including the right to any patent* based on their own intellectual property." (*Id.* at ¶ 68 (emphasis added)) Thus, in light of the way Plaintiffs have pleaded the claim, the claim's gravamen is that Defendants have been enriched because they have declared that they are the inventors of the '433 patent—and that this enrichment is unjust because Mr. Storms is actually the true inventor. This claim, as pleaded, is also preempted by federal patent law. *See James*, 2018 WL 6092461, at *4-5 (finding that the plaintiff's unjust enrichment claim was preempted because it was "fundamentally based on plaintiff's assertion that he should have been named on the '638 patent"); *OptoLum, Inc. v. Cree, Inc.*, 244 F. Supp. 3d 1005, 1014 (D. Ariz. 2017) ("Because OptoLum's unjust enrichment claim depends on the

determination that OptoLum, not Cree, invented the LED technology at issue here, the claim is preempted by federal patent law.").

Here again, because the Court finds that this claim is preempted, it declines to evaluate Defendants' remaining arguments for dismissal.

C. Negligent Misrepresentation (Count V)

The Court turns lastly to Plaintiffs' negligent misrepresentation claim in Count V. Under Louisiana law, the tort of negligent misrepresentation has three elements: (1) there must be a legal duty on the part of the defendant to supply correct information to the plaintiff; (2) there must be a breach of that duty; and (3) the breach must have caused damages to the plaintiff. *Schaumburg v. State Farm Mut. Auto. Ins. Co.*, 421 F. App'x 434, 439-40 (5th Cir. 2011); *Cook v. Am. Gateway Bank*, 49 So. 3d 23, 32 (La. Ct. App. 2010).

Defendants first assert that Count V is preempted because it is "dependent upon [Plaintiffs'] assertion that [Mr.] Storms is an inventor of the '433 patent[.]" (D.I. 33 at 11-12; *see also* D.I. 46 at 2-3) In the Court's view, however, the argument for preemption here is not as strong as it was regarding Counts III and IV.

While Plaintiffs' conversion and unjust enrichment claims clearly turned on whether Mr. Storms is a proper inventor of the '433 patent, the premise of Plaintiffs' negligent misrepresentation claim is a bit different. In Count V, Plaintiffs first allege that Mr. Storms "told [Mr.] McNamara that the cryptocurrency mining systems and related methods were proprietary to Plaintiffs and not to be used or shared outside of Lancium" and that "[Mr.] McNamara gave his word that he would abide by this confidentiality." (D.I. 19 at ¶ 71) The claim then asserts that Plaintiffs relied on Mr. McNamara's assurances that he would "keep the BearBox Technology confidential" and that Plaintiffs would not have continued to share information with

Mr. McNamara had they known that Defendants would violate that promise and incorporate the BearBox Technology into patent applications. (*Id.* at ¶¶ 71-72) As for damages suffered as a result of Defendants' alleged misrepresentation, Plaintiffs allege the loss of potential patent rights as well as the "*costs of Plaintiffs' know-how converted under the guise of a potential business relationship*." (*Id.* at ¶ 73 (emphasis added))

Thus, here the claim as pleaded seems to turn in significant part on whether Mr. McNamara made a representation about confidentiality to Plaintiffs and whether that representation was false; in resolving those questions, whether Mr. Storms was a true inventor is not necessarily a relevant consideration. And Plaintiffs' request for relief is directed, at least in part, to damages for something other than the loss of the ability to license the patent at issue. In light of this, and in light of the lack of caselaw finding negligent misrepresentation claims to be preempted by federal patent law,[10] the Court concludes that Plaintiffs' negligent misrepresentation claim is not preempted. *Cf. HIF Bio, Inc. v. Yung Shin Pharms. Indus. Co.*, 600 F.3d 1347, 1356 (Fed. Cir. 2010) (finding that plaintiffs' causes of action for, *inter alia*, fraud and intentional and negligent interference with contractual relations claims were not preempted, where the inventorship issue was not essential to the resolution of such claims).

However, the Court agrees with Defendants that Count V should nevertheless be dismissed. In this regard, Defendants rightly contend that the claim is fatally flawed because Plaintiffs fail to plead a legal duty on the part of Lancium/Mr. McNamara. (D.I. 33 at 18-20; D.I. 46 at 10)

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[10] Indeed, Defendants acknowledge that they are not aware of any case that specifically addresses preemption of a claim for negligent misrepresentation by federal patent law. (D.I. 33 at 13 & n.2)

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Whether these Defendants owed a duty to Plaintiffs is a question of law. *Barrie v. V.P. Exterminators, Inc.*, 625 So. 2d 1007, 1015 (La. 1993). "[T]he initial inquiry is whether, as a matter of law, a duty is owed to this particular plaintiff to protect him from this particular harm[,]" and "[a] negative answer . . . results in a determination of no liability." *Miller v. Lowe*, Civil Action No. 08-1624, 2009 WL 4730201, at *4 (W.D. La. Dec. 4, 2009) (internal quotation marks and citations omitted).

Plaintiffs, for their part, argue that the Amended Complaint sufficiently pleads "the existence of a duty stemming from the confidential relationship established between the parties." (D.I. 42 at 15) In this regard, the Supreme Court of Louisiana has explained that a confidential or fiduciary relationship giving rise to the requisite duty can exist between "generally all persons who are associated by any relation of trust and confidence" such as, for example, "trustee and beneficiary, attorney and client, parent and child, or husband and wife . . . [and] partners and co-partners, principal and agent, master and servant, physician and patient[.]" *Bunge Corp. v. GATX Corp.*, 557 So. 2d 1376, 1384 n.4 (La. 1990).

None of these types of relationships (or something close to them) are at issue here. Instead, the Amended Complaint pleads that Mr. Storms and Mr. McNamara were simply two men with no previous relationship who met each other at a conference, had dinner and went on to discuss a "potential business relationship"—and that in those conversations, Mr. Storms shared what he considered to be confidential information with Mr. McNamara. (D.I. 19 at ¶¶ 32, 72-73) Plaintiffs cite to no cases suggesting that this type of "business relationship" gives rise to the requisite duty under Louisiana law. And courts applying Louisiana law to circumstances involving similar types of business relationships have found the opposite. *See, e.g.*, *House of Raeford Farms of La. LLC v. Poole*, CIVIL ACTION NO. 19-271, 2021 WL 1081837, at *4-6

(W.D. La. Mar. 18, 2021) (dismissing a fraudulent misrepresentation claim, which similarly requires that a special relationship exist between a plaintiff and defendant establishing a duty to disclose omitted information, where the parties were in a seller-buyer relationship, since fiduciary duties do not arise from "ordinary supplier-customer contracts") (internal quotation marks and citation omitted); *S. Serv. Corp. v. Tidy Bldg. Servs., Inc.*, No. Civ.A. 04-1362, 2004 WL 2784909, at *6 (E.D. La. Dec. 1, 2004) (finding that the plaintiff's complaint failed to state a claim for negligent misrepresentation, where "[t]he relationships between Tidy and its customers and Tidy and [plaintiff] do not fall within the class of special relationships of trust and confidence; they are ordinary commercial relationships"). Plaintiffs' negligent misrepresentation claim therefore fails as a matter of law.

D. Conclusion

In sum, the Court agrees with Defendants that Plaintiffs' conversion and unjust enrichment claims are preempted by federal patent law, and that Plaintiffs' negligent misrepresentation claim is wanting as a matter of law due to the failure to sufficiently allege the requisite duty. Plaintiffs have requested leave to amend the Amended Complaint if Defendants' Motion is granted. (D.I. 42 at 18) The Court believes that this request should be granted as to Counts III and IV because: (1) it is not clear that allowing the opportunity to amend would be a futile act;[11] (2) this is the first time the Court has found Plaintiffs' claims to be deficiently pleaded; and (3) leave to amend should be given freely "when justice so requires." Fed. R. Civ. P. 15(a)(2). As to Count V, however, the Court does not see how Plaintiffs can plead a plausible

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[11] If Plaintiffs are given the opportunity to replead, they should be mindful of Defendants' other arguments for dismissal of these Counts, (D.I. 33 at 14-18), and should address those arguments in the new pleading to the extent they need to, as it is not likely that Plaintiffs would be given a further chance to replead thereafter.

claim (i.e. how Plaintiffs can possibly allege the requisite duty). Thus, the Court also recommends that dismissal of Counts III and IV be without prejudice and that dismissal of Count V be with prejudice. The Court suggests that, to the extent the District Court affirms the Court's recommendation, Plaintiffs be given leave to file one further amended complaint within 14 days. *TriDiNetworks Ltd. v. Signify N. Am. Corp.*, Civil Action No. 19-1063-CFC-CJB, 2020 WL 2839224, at *5 (D. Del. June 1, 2020).

IV. CONCLUSION

For the foregoing reasons, the Court recommends that Defendants' Motion be GRANTED.[12]

This Report and Recommendation is filed pursuant to 28 U.S.C. § 636(b)(1)(B), Fed. R. Civ. P. 72(b)(1), and D. Del. LR 72.1. The parties may serve and file specific written objections within fourteen (14) days after being served with a copy of this Report and Recommendation. Fed. R. Civ. P. 72(b)(2). The failure of a party to object to legal conclusions may result in the loss of the right to *de novo* review in the district court. *See Sincavage v. Barnhart*, 171 F. App'x 924, 925 n.1 (3d Cir. 2006); *Henderson v. Carlson*, 812 F.2d 874, 878-79 (3d Cir. 1987).

The parties are directed to the Court's Standing Order for Objections Filed Under Fed. R. Civ. P. 72, dated October 9, 2013, a copy of which is available on the District Court's website, located at http://www.ded.uscourts.gov.

Dated: January 18, 2022

Christopher J. Burke

Christopher J. Burke
UNITED STATES MAGISTRATE JUDGE

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[12] Defendants' request for oral argument, (D.I. 47), is DENIED.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEAR BOX LLC and AUSTIN STORMS,	)	
	)	
Plaintiffs,	)	
	)	
v.	)	C.A. No. 21-534(MN) CJB)
	)	
LANCIUM LLC, MICHAEL T. MCNAMARA and RAYMOND E. CLINE, JR.,	)	
	)	
Defendants.	)	

ORDER ADOPTING REPORT AND RECOMMENDATION

At Wilmington, this 2nd day of February 2022:

WHEREAS, on January 18, 2022, Magistrate Judge Burke issued a Report and Recommendation ("the Report") (D.I. 92) in this action recommending that the Court grant Defendants' Motion for Judgment on the Pleadings (D.I. 32); and

WHEREAS, no party filed objections to the Report pursuant to Rule 72(b)(2) of the Federal Rules of Civil Procedure in the prescribed period, and the Court finding no clear error on the face of the record.

THEREFORE, IT IS HEREBY ORDERED, that the Report and Recommendation (D.I. 92) is ADOPTED and Defendants' Motion for Judgment on the Pleadings (D.I. 32) is GRANTED. Counts III and IV of Plaintiff's Amended Complaint (D.I. 19) are DISMISSED WITHOUT PREJUDICE and Count V is DISMISSED WITH PREJUDICE.

Plaintiff is given leave to file a further amended complaint on or before February 16, 2022.

Maryellen Noreika
The Honorable Maryellen Noreika
United States District Court Judge

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR. Defendants.	)	C.A. No. 21-534-MN-CJB **JURY TRIAL DEMANDED**

SECOND AMENDED COMPLAINT

Plaintiffs BearBox LLC ("BearBox") and Austin Storms (collectively, "Plaintiffs" or "BearBox") bring this action against Lancium LLC ("Lancium"), Michael T. McNamara, and Raymond E. Cline, Jr. (collectively "Defendants") to correct the inventorship of U.S. Patent No. 10,608,433 (the "'433 Patent") and to recover damages, injunctive relief, declaratory relief, and other remedies for Defendants' wrongful actions to obtain, convert, misuse, disclose, and claim as their own Plaintiffs' proprietary cryptocurrency mining technology. Plaintiffs further allege as follows:

INTRODUCTION

1. This case is about the Defendants' theft and unauthorized use of system designs, data, know-how, and physical documents describing those designs, data, and know-how, as well as inventions that rightfully belong to Plaintiffs.

2. Plaintiffs developed proprietary technology relating to cryptocurrency mining systems. By way of background, BearBox's technology generally relates to an energy-efficient cryptocurrency mining system and related methods that reduce the inefficiency and

environmental impact of energy-intensive mining operations by better utilizing available energy resources to increase the stability of the energy grid, minimize a mining operation's impact on peak-demand, and also alleviate energy oversupply and undersupply conditions. BearBox's technology can be used to mine cryptocurrency, such as Bitcoin.

3. The Defendants deceptively induced the Plaintiffs to disclose BearBox's technology to them under the guise of a possible business deal or "collaboration," a word used by McNamara in encouraging Plaintiffs' disclosures, between Defendants and Plaintiffs to jointly commercialize the BearBox Technology.

4. The Defendants stole BearBox's technology, including system designs, documents, data, and know-how, from Plaintiffs by converting it and using it to modify Defendants' software, e.g. Smart Response™, to operate as BearBox's technology did, and then selling, licensing, seeking investments in support of, and otherwise monetizing that modified Smart Response™ software for great profit.

5. Defendants went even further, by filing a U.S. patent application, which later matured into the '433 Patent, that wrongfully disclosed portions of BearBox's technology to the U.S. Patent and Trademark Office and ultimately to the public as technology that was invented by Defendants. The claimed subject matter of the '433 Patent falls fully within the scope of BearBox's technology, though is not a complete representation of the BearBox technology. By obtaining the '433 Patent with claims directed to portions of BearBox's technology, the Defendants have wrongfully obtained a patent that prevents Plaintiffs from building their own system, or otherwise monetizing their system designs, data, documents, and know-how.

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6. Plaintiffs bring this action to recover damages caused by Defendants' theft and unauthorized use, and subsequent exploitation of Plaintiffs system design, data, documents, and know-how.

7. Plaintiffs also bring this action to correct the named inventors on the '433 Patent. The inventions claimed in the '433 Patent are inventions conceived by Storms, founder and president of BearBox.

PARTIES

8. BearBox LLC is a limited liability company organized and existing under the laws of Louisiana with its principal place of business at 4422 Highway 22, Mandeville, Louisiana 70471.

9. Plaintiff Austin Storms is an individual residing in Mandeville, Louisiana.

10. On information and belief, Defendant Lancium is a Delaware limited liability company with its principal place of business at 6006 Thomas Rd, Houston, Texas 77041. On information and belief, Lancium has a registered agent capable of accepting service in this district, Harvard Business Services, Inc. with a place of business at 16192 Coastal Highway, Lewes, DE 19958.

11. On information and belief, Defendant Michael T. McNamara is the Chief Executive Officer and a founder of Lancium and resides in Newport Beach, California. Defendant McNamara is named as a purported inventor on the face of the '433 Patent.

12. On information and belief, Defendant Raymond E. Cline, Jr. is the Chief Computing Officer of Lancium and resides in Houston, Texas. Defendant Cline is named as a purported inventor on the face of the '433 Patent.

JURISDICTION

13. This is an action seeking correction of the named inventors of a United States patent under 35 U.S.C. § 256. As such, this action arises under the laws of the United States.

14. This Court has exclusive subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a) because the matter arises under an Act of Congress relating to patents, specifically 35 U.S.C. § 256.

15. The Court has supplemental jurisdiction under 28 U.S.C. § 1367 over all asserted claims under state law because those claims are so related to the claims in this action that arise under federal law that they form part of the same case or controversy.

16. The Court also has jurisdiction pursuant to 28 U.S.C. § 1332, as complete diversity of citizenship exists among the parties, and the amount in controversy exceeds $75,000. Plaintiff BearBox is a citizen of the State of Louisiana because it is organized under the laws of the State of Louisiana and has its principal place of business in the State of Louisiana. Plaintiff Storms is a citizen of the State of Louisiana because he resides in the State of Louisiana. In contrast, none of the Defendants are citizens of the State of Louisiana. Defendant Lancium is a citizen of the States of Delaware and Texas because it is organized under the laws of the State of Delaware and has its principal place of business in the State of Texas. Defendant McNamara is a citizen of the State of California because he resides in the State of California. Defendant Cline is a citizen of the State of Texas because he resides in the State of Texas. Therefore, because the Plaintiffs are both citizens of the State of Louisiana (and no other states) for purposes of diversity jurisdiction, and none of the Defendants are citizens of the State of Louisiana, complete diversity exists among the parties.

17. This Court has general personal jurisdiction over Lancium because it is organized under the laws of the State of Delaware and because it maintains an ongoing presence in this District at least through its registered agent.

18. This Court has specific personal jurisdiction over each of Defendants McNamara and Cline at least under Title 6 of the Delaware Code, § 18-109(a).

19. On information and belief, Defendant McNamara is the Chief Executive Officer of Lancium. On information and belief, as the Chief Executive Offer, McNamara participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

20. McNamara is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from the interests of Lancium and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claims against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant McNamara together. Plaintiffs' claims against Defendant McNamara arise out of his exercise of his powers as Chief Executive Officer of Lancium.

21. On information and belief, Defendant Cline is the Chief Computing Officer of Lancium. On information and belief, as the Chief Computing Officer, Cline participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

22. Cline is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from Lancium's interest and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claim against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant Cline together.

Plaintiffs' claims against Defendant Cline arise out of his exercise of his powers as Chief Computing Officer of Lancium.

23. The actions of Defendants McNamara and Cline establish sufficient minimum contacts with Delaware under Delaware law and the United States Constitution to give this Court personal jurisdiction over each of them.

24. As described below, each Defendant has committed acts giving rise to this action.

VENUE

25. Venue is proper in this District under 28 U.S.C. § 1391(b)(3) because there is no district in which an action may otherwise be brought as provided in § 1391(b) and Defendant Lancium is subject to the Court's personal jurisdiction with respect to this action.

PLAINTIFFS' PROPRIETARY CRYPTOCURRENCY MINING TECHNOLOGY

26. As of 2018, the amount of energy required to process computer algorithms to mine cryptocurrencies like Bitcoin was three times greater than the energy required to physically mine gold. Conventional mining of "copper, gold, platinum, and rare earth oxides are 4, 5, 7, and 9 megajoules to generate one U.S. dollars," while "it costs an average of 17 megajoules to mine $1 worth of bitcoin."[1] The large amount of energy required to mine cryptocurrencies can make such mining financially prohibitive, and even when financially lucrative, the energy required for cryptocurrency mining can be harmful to the environment, with studies showing potential carbon dioxide emissions from cryptocurrency mining "single-handedly rais[ing] global temperatures by 2 degrees by 2023." *Id*.

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[1] https://www.marketwatch.com/story/mining-bitcoin-is-3-times-more-expensive-than-mining-gold-research-paper-finds-2018-11-06

27. At the same time, some forms of electrical power generation, such as wind, solar, or other types of variable renewable energy sources, are inefficient and suffer from a timing imbalance between peak demand and energy production. Additionally, these non-dispatchable renewable energy sources cannot be controlled by operators in response to dynamically changing grid conditions. As a result, these renewable energy sources and their operators frequently sell power at low or negative prices, sometimes even being curtailed or shut down entirely, until demand increases and grid conditions change.

28. Because cryptocurrency mining using proof-of-work is a computationally demanding process, it requires a significant amount of energy to operate. As a result, industrial-scale cryptocurrency mining places a large energy burden on the power grid, driving demand and costs as well as increasing the likelihood of transmission or other grid component failure if not managed correctly.

29. In late 2018 and early 2019, Austin Storms sought to address these problems by developing energy-efficient cryptocurrency mining systems and methods that reduce the environmental impact of energy-intensive mining operations. Storms conceived of a system that better uses available energy resources to increase the stability of the energy grid, minimize a mining operation's impact on peak-demand, and help alleviate energy oversupply and undersupply conditions, all while decreasing the overall energy costs of the mining operation and increasing its profitability.

30. Austin Storms conceived of and developed BearBox's technology. Storms is the president and founder of BearBox. BearBox's technology includes hardware and software components. Structurally, BearBox's technology includes a housing for a plurality of miners (such as ASICs, graphics cards, or the like) under the direction of a smart controller(s).

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31. In BearBox's technology, a controller (such as a power distribution unit, network interface, computer, and/or the like) monitors various external factors, such as current and expected energy demand/pricing information, current and expected cryptocurrency pricing, current and expected network hashrate and difficulty, and the like. Based on these external factors, the controller(s) determines appropriate times to mine cryptocurrency in accordance with a desired performance strategy (for example, profitability thresholds). At the appropriate times, the controller initiates mining, for example, by powering on a number of miners based on various conditions internal and external conditions.

DEFENDANTS WRONGFULLY STOLE BEARBOX'S TECHNOLOGY

32. In May 2019, Storms attended the Fidelity FCAT Mining Summit in Boston, Massachusetts on behalf of BearBox to promote BearBox's technology and seek potential customers for his revolutionary system.

33. While at the conference, Storms met Defendant McNamara. Defendant McNamara showed immediate interest in BearBox's technology. Under the rouse of a potential business relationship, McNamara deceptively pumped Storms for details about BearBox's technology over the course of several exchanges, which included conversations, emails, and text messages about BearBox's technology. Storms took McNamara to dinner where McNamara continued to pump Storms for details about BearBox's technology.

34. Following the conference, McNamara continued to press Storms for additional details about BearBox's technology via text messaging and email. Storms described BearBox's technology and provided annotated system diagrams, component specifications, and modeled data sets to mimic real-world Bitcoin variables such as Bitcoin price and network hashrate, energy prices, time intervals, and power thresholds, and computed profitability figures. Storms

communications to McNamara about BearBox's technology was for the sole purpose of potential partnership. Storms included express confidentiality notices in his email communications with Defendant McNamara.

35. After Storms disclosed BearBox's technology to McNamara, McNamara abruptly ended all communications with Storms.

36. Storms last communicated with McNamara on May 9, 2019 via e-mail, and after sending that message, Storms did not hear from McNamara again.

37. At that time, Storms understood that McNamara was not interested in investing in or collaborating with BearBox's technology. But Storms had no reason to suspect that Defendants were being deceptive and would steal BearBox's technology, including the system designs, diagrams, data, documents, and know-how, and use it to build Defendants' own system that would function as BearBox's technology did.

38. In the days, weeks, and months following Plaintiffs' disclosures to McNamara, Defendants began working with partners, outside consultants, and vendors to help Defendants bring BearBox's technology to market, labeled as Defendants' own system. Defendants efforts included working internally to modify their Smart Response™ software to work as BearBox's technology did.

39. Defendants soon became confident they could exploit BearBox's technology for profit by modifying their Smart Response™ software, and then using, selling, licensing, and otherwise monetizing that modified Smart Response™ software, but Defendants also realized that others would eventually learn of Defendants' new-and-improved Smart Response™ software, now with the benefits of BearBox's technology, and may copy it in order to compete with Defendants.

40. Defendants believed that the profits they would realize from exploiting their modified Smart Response™ software would be significantly reduced if outside competitors were allowed to copy Defendants' unauthorized use of BearBox's technology and compete directly with Defendants.

41. Because of these realizations, Defendants hatched a plan to patent some of the profitable attributes of BearBox's technology. If such a patent was obtained, Defendants believed that such a patent would effectively grant Defendants a monopoly to exploit significant portions of BearBox's technology for profits that would far exceed any profits should Defendants be left to compete with others, including BearBox.

42. On information and belief, Defendants filed U.S. provisional patent application No. 62/927,119 on October 28, 2019, naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

43. In addition to falsely claiming to be the inventors of the inventions disclosed in the application, Defendants wrongfully disclosed, without authorization, portions of BearBox's technology to the United States Patent and Trademark Office.

44. Likewise, on December 4, 2019, Defendants filed U.S. Patent Application Serial No. 16/702,931, once again naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

45. The '433 Patent issued on March 31, 2020 naming Defendants McNamara and Cline as the sole purported inventors on the face of the patent. A true and correct copy of the '433 Patent is attached hereto as Exhibit A.

46. The inventions claimed in the '433 patent fall within the scope of BearBox's technology, yet Defendants falsely identified themselves as the inventors of the claimed

inventions, when, in fact, Storms is the sole inventor of the claimed inventions. Not all aspects of BearBox's technology that was stolen and used by Defendants was described and claimed in the '433 Patent. For example, Defendants theft and unauthorized use included confidential aspects of BearBox technology's system design, diagrams, data, and know-how to modify Defendants' Smart Response software to develop and exploit, among other things, methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy values.

47. On information and belief, McNamara and Cline assigned their purported rights in the '433 patent to Lancium. On information and belief, at all times, Lancium was aware that McNamara and Cline, both officers of Lancium, were not the rightful inventors of BearBox's technology disclosed in the patent and the inventions claimed in the patent.

48. Defendants McNamara and Cline each submitted signed declarations falsely swearing that they were "an original joint inventor" of the claimed subject matter. A true and correct copy of Defendant McNamara's and Defendant Cline's declarations are attached as Exhibit B.

49. On June 19, 2020, Defendants announced that its Smart Response™ software allowed it to qualify as the "first successful load-only Controllable Load Resource (CLR) designation," which Defendants described as a "breakthrough achievement," that allows for dispatching "excess energy into the grid during times when energy is most expensive," adding that "with this revolutionary advancement, data centers will also be able to earn additional revenue providing ancillary services to ERCOT."

50. Since then, Defendants have used BearBox's technology, including the stolen system designs, diagrams, data, and know-how, and its subsequently-modified Smart Response™ software to function as it did, to allow Defendants to profit significantly from use,

license, sale, and investments related to its modified Smart Response™ software. Defendants are not, and have never, been entitled to these profits.

51. In addition to illegally profiting from its theft and subsequent use of BearBox's technology, Defendants made use of its ill-gotten '433 patent.

52. On August 14, 2020, Lancium filed a lawsuit in the U.S. District Court for the Western District of Texas against Layer1 Technologies, Inc. ("Layer1") asserting that Layer1 infringes the '433 patent, and stating that "Lancium's Controllable Load Resource Technology attracted the interest of many companies, including, upon information and belief, Layer1." That case is captioned *Lancium LLC v. Layer1 Technologies, Inc.*, Case No. 6:20-cv-739 (W.D. Texas) (the "Layer1 Lawsuit").

53. As part of the Layer1 Lawsuit, Defendants falsely asserted that McNamara and Cline are the sole inventors of the inventions claimed in the '433 patent.

54. Plaintiffs became aware of Defendants' wrongful use of BearBox's technology on or about August 17, 2020, when they learned about the Layer1 Lawsuit through a press release dated August 14, 2020, posted by Lancium on PRNewswire. That press release is available at the following URL: https://www.prnewswire.com/news-releases/controllable-load-resource-clr-market-leader-lancium-files-patent-infringement-lawsuit-against-layer1-301112687.html.

55. Before seeing the August 14, 2020 press release, Plaintiffs were unaware of Defendants' wrongful use of BearBox's technology and was unaware of the '433 patent.

56. On March 5, 2021, Lancium and Layer1 entered a Stipulation to Dismiss with Prejudice in the Layer1 Lawsuit. According to the stipulation, the parties had entered a Settlement Agreement to resolve the Layer1 Lawsuit.

57. According to a press release issued by Lancium on March 8, 2021, Lancium and Layer 1 "have entered into a mutually beneficial partnership. Layer1 has licensed Lancium's intellectual property and Lancium will provide Smart Response™ software and services to Layer1." The press release is available at the following URL: https://www.prnewswire.com/news-releases/lancium-and-layer1-settle-patent-infringement-suit-301242602.html.

COUNT I
CORRECTION OF INVENTORSHIP FOR THE '433 PATENT: AUSTIN STORMS AS SOLE INVENTOR

58. Plaintiffs incorporate the above paragraphs by reference.

59. Storms is the sole inventor of the subject matter claimed in the '433 Patent.

60. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the '433 patent and the currently listed inventors on the '433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms or BearBox.

61. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the '433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT II
IN THE ALTERNATIVE, CORRECTION OF INVENTORSHIP FOR THE '433 PATENT: AUSTIN STORMS AS JOINT INVENTOR WITH THE CURRENTLY NAMED INVENTORS

62. Plaintiffs incorporates the above paragraphs by reference.

63. In the alternative, Storms is a joint inventor of the subject matter claimed in the '433 Patent and should be added to the individuals currently named as inventors on the '433 Patent.

64. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the ’433 patent and the currently listed inventors on the ’433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms.

65. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the ’433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT III
TRADE SECRET MISAPPROPRIATION UNDER
FEDERAL DEFEND TRADE SECRETS ACT, 18 U.S.C. § 1836

66. Plaintiffs incorporate the above paragraphs by reference.

67. At all relevant times, Plaintiffs and Defendants were engaged in interstate commerce. For example, Plaintiffs and Defendants are engaged in trade and business, developing and testing, among other things, cryptocurrency mining systems and related methods in interstate commerce throughout the United States.

68. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about BearBox’s technology relating to certain features, including methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy values. Such information constitutes trade secrets of substantial economic value, at least because methods for energy value arbitrage may be used for substantial profit. This confidential technical information was not known to the public or to other persons who can obtain economic value from its disclosure or use. This information constituted a trade secret under the Defend Trade Secrets Act, 18 U.S.C. §§ 1836.

69. Defendants knew the information they received from Austin Storms about BearBox's technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship, and was in no way the information received to be used by Defendants' for their own profit. McNamara himself referred to the exchanges with Plaintiffs' "lots of stuff to collaborate on." Defendants further knew the technical information they received from Storms about BearBox's technology was confidential based upon Defendants' own actions taken to protect that information once they possessed it, and misappropriated it by using in modification of their Smart Response™ software. Defendants' restricted access to the information, including as it was represented in the Smart Response™ software, required confidentiality agreements for third party customers, potential customers, and licensees, and other internal measures were taken.

70. Plaintiffs included a confidentiality designation on communications to which the confidential trade secret information was attached. Plaintiffs took additional reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of individuals that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its computers. The confidential information was, at all other times, secured on a password protected computer. The confidential information was not externally accessible through the internet. When that password protected computer was not attended, it was secured in a locked building at Storms residence, which included other security measures such as a concierge and elevator keys.

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71. For the very limited number of additional occasions the confidential, trade secret information was shared, it was shared with a person or entity subject to contractual obligations regarding confidentiality and/or prohibitions on unauthorized use. For the limited number of occasions BearBox shared the confidential, trade secret information with potential customers, it was done only with BearBox management approval.

72. Defendants misappropriated Plaintiffs' trade secrets when they used BearBox technology, without Plaintiffs' authorization, in at least its Smart Response™ software. Defendants have disclosed and/or used the confidential information without the express or implied consent of Plaintiffs. The acts of taking Plaintiffs' confidential information, and using it as Defendants' own, and without permission was improper. Further, Defendant McNamara agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.

73. As a result of Defendants' misappropriation of Plaintiffs' trade secrets, Plaintiffs' have suffered and will suffer damages or other financial harm in an amount to be proven at trial including, but not limited to, damages for actual loss caused by the misappropriation of the trade secrets, financial loss for any unjust enrichment caused by the misappropriation of the trade secrets, and/or damages caused by the misappropriation measured by imposition of liability.

74. The Defendants willfully and maliciously misappropriated the Plaintiffs' trade secrets, and Plaintiffs are therefore entitled to an award of exemplary damages and an award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(C), (D).

COUNT IV
TRADE SECRET MISAPPROPRIATION UNDER LOUSIANA CIVIL PRACTICE AND REMEDIES CODE, TITLE 51, SECTION 13-A

75. Plaintiffs incorporate the above paragraphs by reference.

76. At all relevant times, Plaintiffs and Defendants were engaged in trade or commerce within the meaning of La. R.S. 51:1431-39 (2011), the Louisiana Uniform Trade Secrets Act. For example, Plaintiffs and Defendants are engaged in trade and business, developing and testing, among other things, cryptocurrency mining systems and related methods.

77. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about BearBox's technology relating to certain features, such as methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy values. Such information constitutes trade secrets of substantial economic value, at least because methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy valuesmay be used for substantial profit. This confidential technical information was not known to the public or to other persons who can obtain economic value from its disclosure or use. This information constituted a trade secret under the Louisiana Uniform Trade Secret Act.

78. Defendants knew the technical information they received from Austin Storms about BearBox's technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship, and was in no way the information received to be used by Defendants' for their own profit. Defendants further knew the information they received from Storms about BearBox's technology was confidential based upon Defendants' own actions taken to protect that information once they possessed it. Defendants' restricted access to the

information, required confidentiality agreements for third party customers, potential customers, and licensees, and other internal measures were taken. Defendants further took these actions to protect Plaintiffs' confidential information after Defendants misappropriated it by including it for use in Defendants' Smart Response™ software.

79. Plaintiffs included a confidentiality designation on communications to which the confidential trade secret information was attached. Plaintiffs took additional reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of collaborators that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its computers. The confidential information was, at all other times, secured on a password protected computer. The confidential information was not externally accessible through the internet. When that password protected computer was not attended, it was secured in a locked building.

80. For the very limited number of additional occasions the confidential, trade secret information was shared, it was shared with a person or entity subject to contractual obligations regarding confidentiality and/or prohibitions on unauthorized use. For the limited number of occasions BearBox shared the confidential, trade secret information with potential customers, it was done only with BearBox management approval.

81. Defendants misappropriated Plaintiffs' trade secrets when they used BearBox technology, without Plaintiffs' authorization, in at least its Smart Response™ software. Defendants have disclosed and/or used the confidential technical information without the express or implied consent of Plaintiffs. The acts of taking Plaintiffs' confidential information, and using it as Defendants' own, and without permission was improper. Further, Defendant McNamara

agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.

82. As a result of Defendants' misappropriation of Plaintiffs' trade secrets, Plaintiffs' have suffered and will suffer damages or other financial harm in an amount to be proven at trial including, but not limited to, damages for actual loss caused by the misappropriation of the trade secrets, financial loss for any unjust enrichment caused by the misappropriation of the trade secrets, and/or damages caused by the misappropriation measured by imposition of liability.

83. The Defendants willfully and maliciously misappropriated the Plaintiffs' trade secrets, and Plaintiffs are therefore entitled to an award of exemplary damages and an award of reasonable attorney's fees under § 51:1434.

COUNT V
CONVERSION BY LANCIUM, MCNAMARA, AND CLINE

84. Plaintiffs incorporates the above paragraphs by reference.

85. Austin Storms, in his capacity as founder and President of BearBox, conceived, developed, and reduced to practice BearBox's technology. Plaintiffs own BearBox's technology, including system designs, documents, data, and know-how. Plaintiffs owned this property during all relevant time periods in this suit.

86. Defendants induced Plaintiffs to provide information and documents regarding BearBox's technology to Defendants by misrepresenting that Defendants were interested in investing in or otherwise collaborating with BearBox. Information and documents regarding BearBox's technology were provided to Defendants solely for the purposes of evaluation for a potential business relationship.

87. Without Plaintiffs' consent, Defendants intentionally and willfully assumed dominion and control over BearBox's technology, including system designs, documents, data, and know-how, and improperly used it to modify their Smart Response™ software, and corresponding system designs, to function as reflected in BearBox's system designs, documents, data, and know-how, and subsequently used, sold, licensed, and procured investments related to, and otherwise monetized, that software for substantial profit.

88. Defendants' unlawful exercise of dominion over confidential Bearbox technology, including system designs, documents, data, and know-how not otherwise found to be a trade secret, or having value beyond the value of the trade secret(s), has permanently interfered with Plaintiffs' valuable property rights.

89. Despite providing Defendants with the system designs, documents, data, and know-how that allowed Defendants to modify their Smart Response™ software, and corresponding system designs, Defendants have not compensated or recognized Plaintiffs for the use of BearBox's technology. Defendants' actions constitute an improper and unauthorized use of Plaintiffs' property.

90. As a result of Defendants' improper and unauthorized use of Plaintiffs' system designs, documents, data, and know-how to reconstruct and use Bearbox's technology, Plaintiffs have suffered and will continue to suffer damages and other financial harms in an amount to be proven at trial. As such, Plaintiffs are entitled to damages resulting from Defendants' improper and unauthorized use.

COUNT VI
UNJUST ENRICHMENT BY LANCIUM, MCNAMARA, AND CLINE

91. Plaintiffs incorporate the above paragraphs by reference.

92. Plaintiffs conferred a benefit on Defendants by providing them valuable technology, specifically BearBox's technology, including system designs, documents, data, and know-how.

93. Defendants pressed Storms to provide more information and materials, having recognized the benefit that Defendants received by having access to system designs, documents, data, and know-how reflecting BearBox's technology.

94. Defendants induced Plaintiffs to provide these system designs, documents, data, and know-how by misrepresenting that Defendants were interested in investing in or otherwise collaborating with Bearbox. Defendants' actions in obtaining Plaintiffs' system designs, documents, data, and know-how were deceptive.

95. Defendants retained BearBox's technology, including system designs, documents, data, and know-how, and used it to their own advantage, and at BearBox's expense.

96. Defendants have been and continue to be unjustly enriched by profiting from their wrongful conduct. For example, without Plaintiffs' consent, Defendants used Plaintiffs' system designs, documents, data, and know-how to modify their Smart Response™ software to function as BearBox's technology did. As a result, Defendants are deriving an unjust benefit from exploiting BearBox's property.

97. Despite providing Defendants with the system designs, documents, data, and know-how that allowed Defendants to modify their system designs and Smart Response™ software to function as BearBox's technology did, Defendants have not compensated Plaintiffs for the use of BearBox's technology. It would be inequitable for Defendants to retain these benefits under these circumstances.

98. Defendants' unauthorized use of Bearbox's technology has impoverished Plaintiffs by depriving them of the fruits of their labor. In addition to the costs incurred and labor expended in creating Bearbox's technology, Plaintiffs are no longer able to obtain any economic benefit from any use of Bearbox's technology.

99. Defendants' enrichment through the use of Plaintiffs' system designs, documents, data, and know-how to reconstruct and use Bearbox's technology is directly connected to Plaintiffs' impoverishment because Defendants have failed to compensate Plaintiffs for their efforts.

100. There is no justification at law or in contract for Defendants' uncompensated use of Plaintiffs' unique and novel invention.

101. Because Plaintiffs have incurred, and continue to incur, detriment in the form of loss of money and property as a result of Defendants' wrongful use of system designs, documents, data, and know-how reflecting BearBox's technology, Plaintiffs are entitled to compensation to the extent Defendants have been enriched or Plaintiffs have been impoverished.

JURY DEMAND

102. Under Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiffs respectfully demand a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, BearBox respectfully requests the following relief:

A. An order that the Director of the United States Patent and Trademark Office correct the inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

B. Alternatively, an order that Defendants sign the requisite documents to correct inventorship of the ’433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the ’433 Patent;

C. A declaration that Austin Storms is the sole inventor, or, in the alternative, is a joint inventor to one or both of the individuals currently listed as inventors on the ’433 Patent;

D. A preliminary and a permanent injunction enjoining Defendants Lancium, McNamara, and Cline from asserting that McNamara or Cline are inventors of the ’433 Patent in violation of the United States federal patent laws;

E. An order that Defendants immediately transfer to Plaintiffs all right, title, and interest in all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of BearBox’s technology;

F. An order for a constructive trust over all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of BearBox’s technology or any system designs, documents, data, and know-how reflecting BearBox’s technology;

G. Financial relief including damages, consequential damages, disgorgement of Defendants’ ill-gotten profits, Defendants’ unjust enrichment, reliance damages, and/or all other appropriate financial relief, all in an amount to be determined at trial, with interest;

H. An award of the amount by which Defendants have been unjustly enriched by their actions set forth in this Complaint;

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I. A finding that this is an exceptional case warranting imposition of attorney fees against Defendants and an award to Plaintiffs of its reasonable costs and attorney fees incurred in bringing this action pursuant to 35 U.S.C. § 285;

J. An award of exemplary damages and/or an award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(C), (D) and/or under La. R.S. § 51:1434; and

K. An award of such further relief at law or in equity, such as preliminary and/or permanent injunctive relief, as the Court deems just and proper.

ASHBY & GEDDES

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Dated: February 16, 2022

EXHIBIT A

US010608433B1

(12) **United States Patent**
McNamara et al.

(10) **Patent No.: US 10,608,433 B1**
(45) **Date of Patent: Mar. 31, 2020**

(54) **METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT**

(71) Applicant: **Lancium LLC**, Houston, TX (US)

(72) Inventors: **Michael T. McNamara**, Newport Beach, CA (US); **Raymond E. Cline, Jr.**, Houston, TX (US)

(73) Assignee: **Lancium LLC**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/702,931**

(22) Filed: **Dec. 4, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/927,119, filed on Oct. 28, 2019.

(51) **Int. Cl.**
H02J 3/14 (2006.01)
H02J 3/00 (2006.01)
G06F 1/3203 (2019.01)

(52) **U.S. Cl.**
CPC ***H02J 3/14*** (2013.01); ***G06F 1/3203*** (2013.01); ***H02J 3/008*** (2013.01)

(58) **Field of Classification Search**
CPC H02J 3/14; H02J 3/008; G06F 1/3203
See application file for complete search history.

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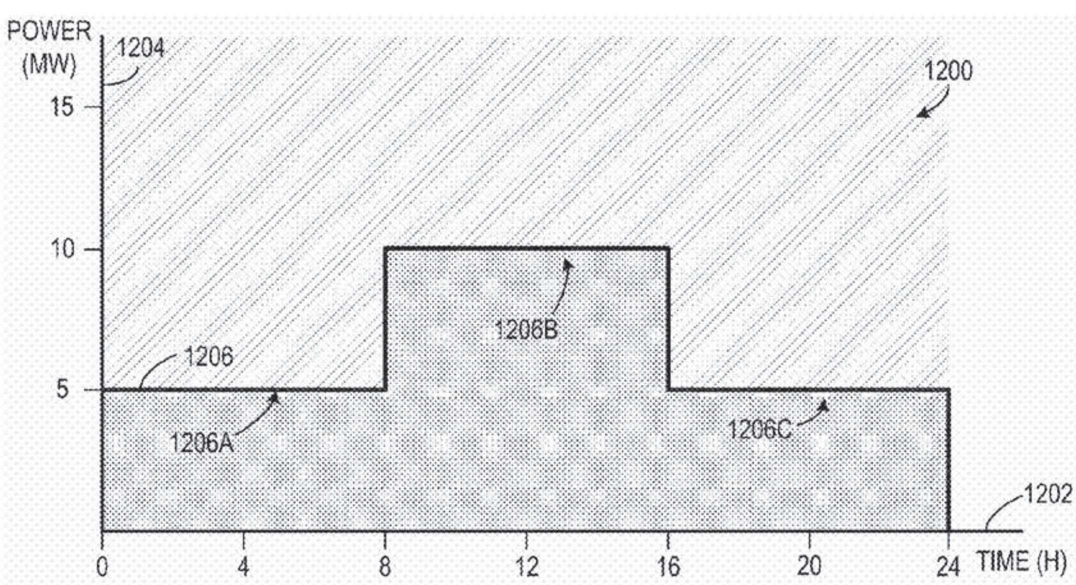
Primary Examiner — Christopher E. Everett
(74) *Attorney, Agent, or Firm* — McDonnell Boehnen Hulbert & Berghoff LLP

(57) **ABSTRACT**

Examples relate to adjusting load power consumption based on a power option agreement. A computing system may receive power option data that is based on a power option agreement and specify minimum power thresholds associated with time intervals. The computing system may determine a performance strategy for a load (e.g., set of computing systems) based on a combination of the power option data and one or more monitored conditions. The performance strategy may specify a power consumption target for the load for each time interval such that each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The computing system may provide instructions the set of computing systems to perform one or more computational operations based on the performance strategy.

20 Claims, 16 Drawing Sheets



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2013/0227139	A1	8/2013	Suffling	
2013/0306276	A1	11/2013	Duchesneau	
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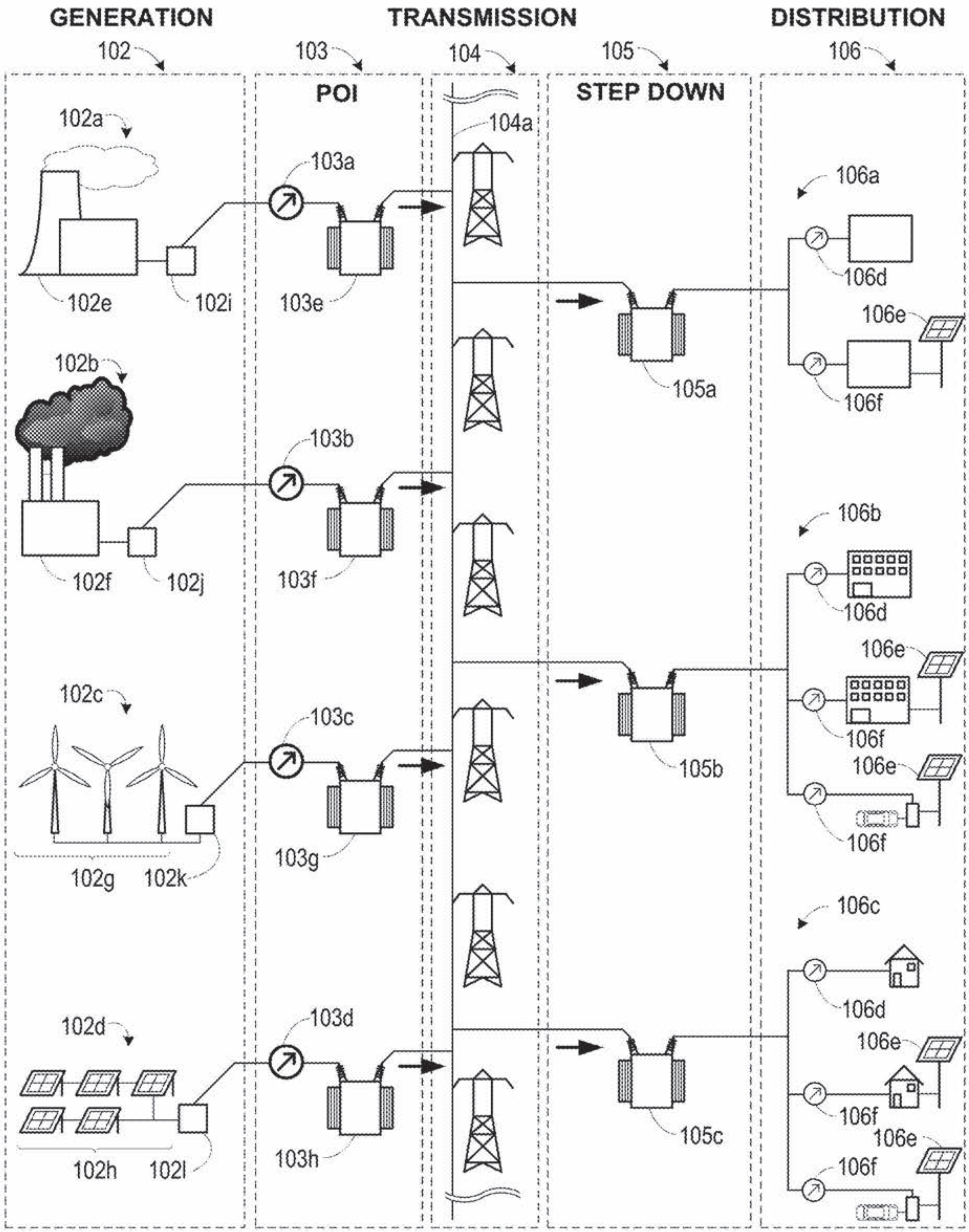

PRIOR ART
FIGURE 1

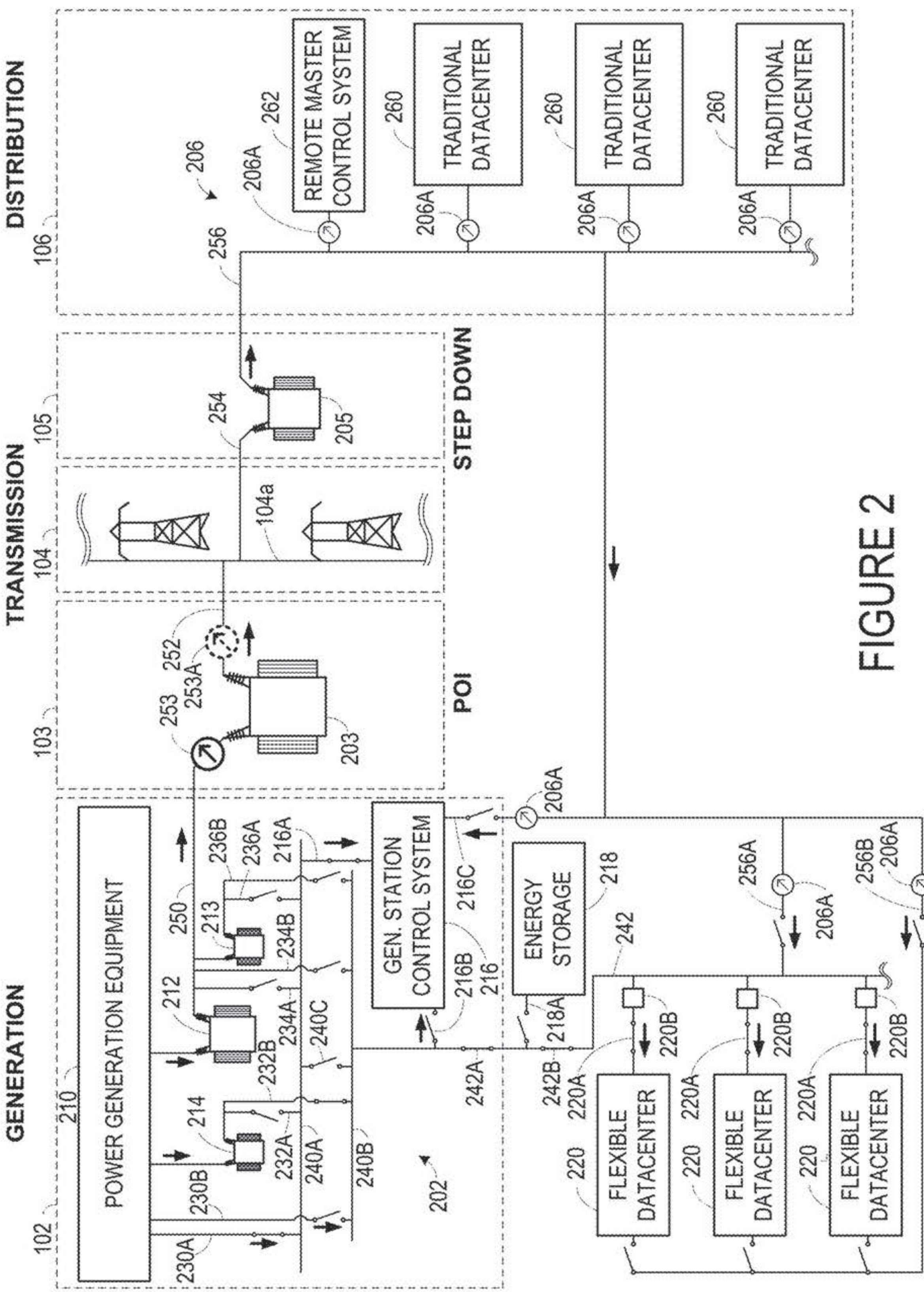
GENERATION
102
210
POWER GENERATION EQUIPMENT
230A
230B
214
212
213
232A
232B
234A
234B
236A
236B
240A
240B
240C
250
216A
216B
216C
216
GEN. STATION CONTROL SYSTEM
202
242A
242B
242
ENERGY STORAGE
218
218A
FLEXIBLE DATACENTER
220
220A
220B
256A
256B
206A
103
POI
253
253A
252
203
TRANSMISSION
104
104a
105
STEP DOWN
254
205
DISTRIBUTION
106
206
256
262
REMOTE MASTER CONTROL SYSTEM
260
TRADITIONAL DATACENTER

FIGURE 2

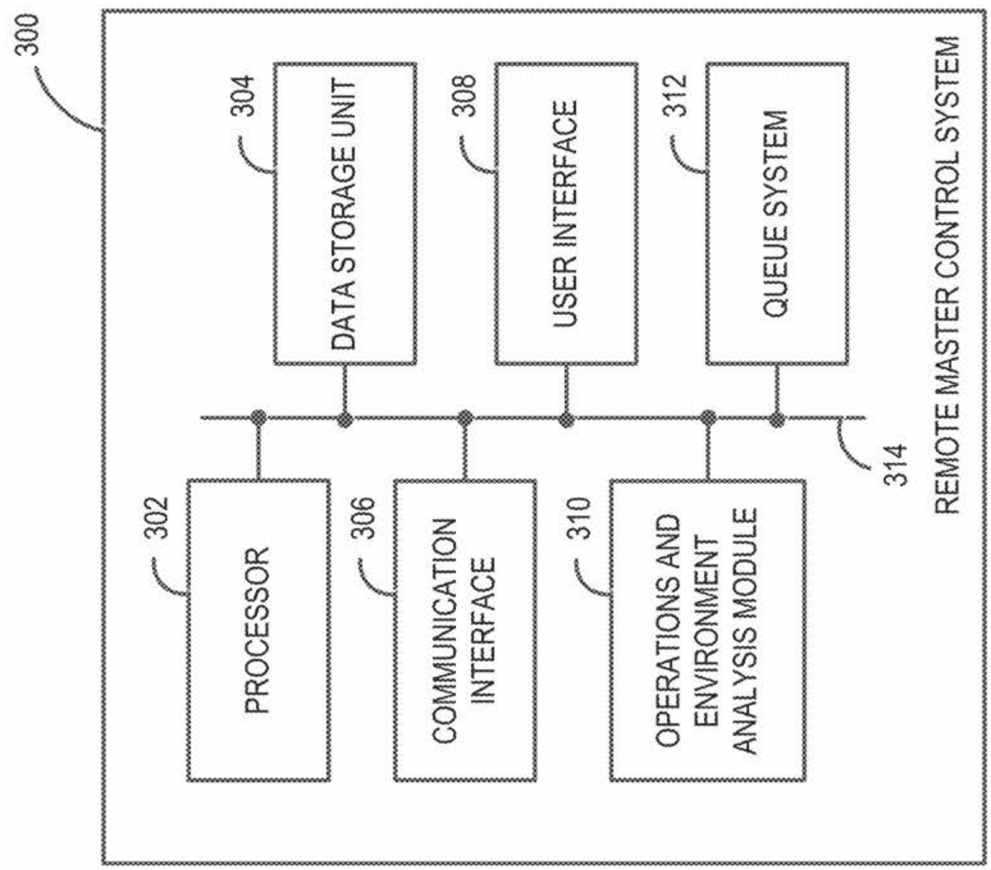
300
302
PROCESSOR
304
DATA STORAGE UNIT
306
COMMUNICATION INTERFACE
308
USER INTERFACE
310
OPERATIONS AND ENVIRONMENT ANALYSIS MODULE
312
QUEUE SYSTEM
314
REMOTE MASTER CONTROL SYSTEM

FIGURE 3

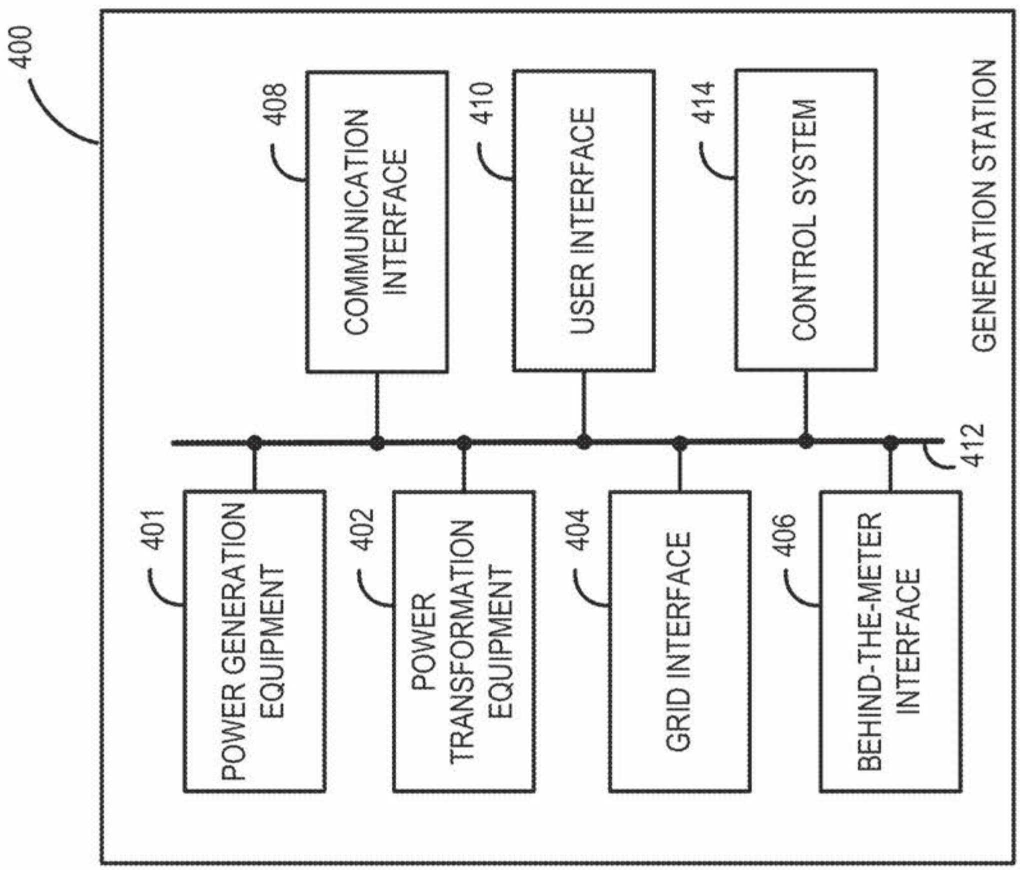
400
GENERATION STATION
408
COMMUNICATION INTERFACE
410
USER INTERFACE
414
CONTROL SYSTEM
412
401
POWER GENERATION EQUIPMENT
402
POWER TRANSFORMATION EQUIPMENT
404
GRID INTERFACE
406
BEHIND-THE-METER INTERFACE

FIGURE 4

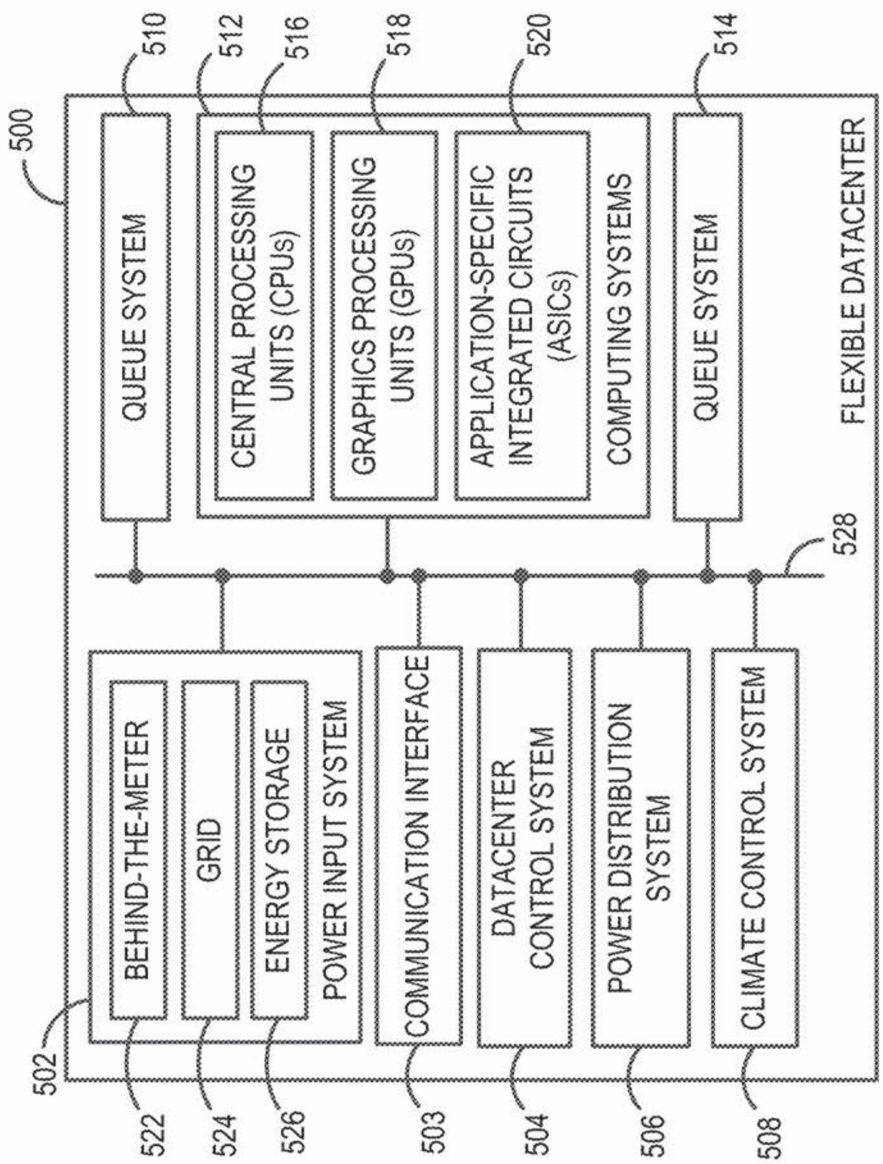
500
510
512
516
518
520
514
QUEUE SYSTEM
CENTRAL PROCESSING UNITS (CPUs)
GRAPHICS PROCESSING UNITS (GPUs)
APPLICATION-SPECIFIC INTEGRATED CIRCUITS (ASICs)
COMPUTING SYSTEMS
QUEUE SYSTEM
FLEXIBLE DATACENTER
528
BEHIND-THE-METER
GRID
ENERGY STORAGE
POWER INPUT SYSTEM
COMMUNICATION INTERFACE
DATACENTER CONTROL SYSTEM
POWER DISTRIBUTION SYSTEM
CLIMATE CONTROL SYSTEM
502
522
524
526
503
504
506
508

FIGURE 5

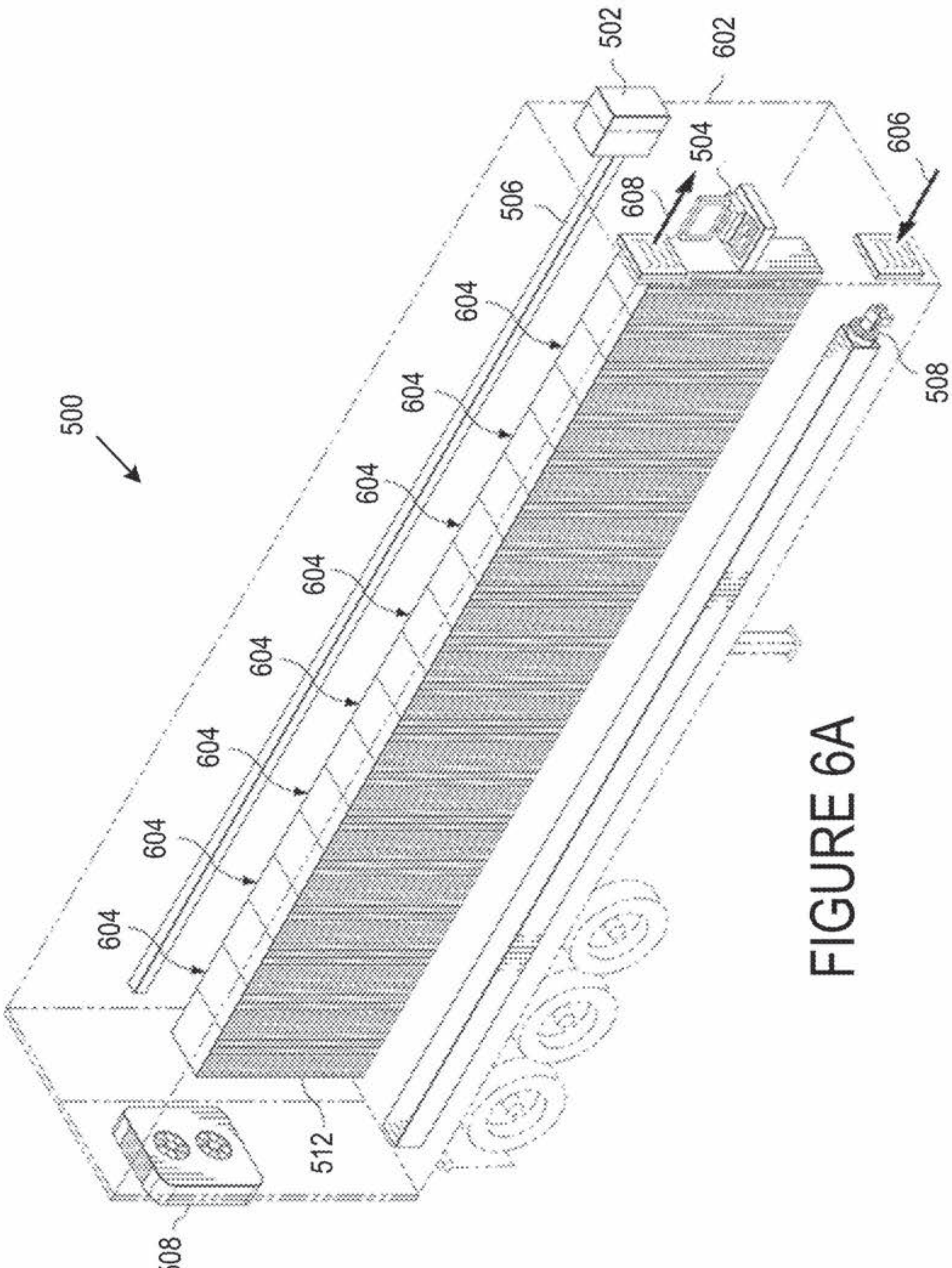
500
502
602
504
606
506
608
604
604
604
604
604
604
604
604
508
512
508

FIGURE 6A

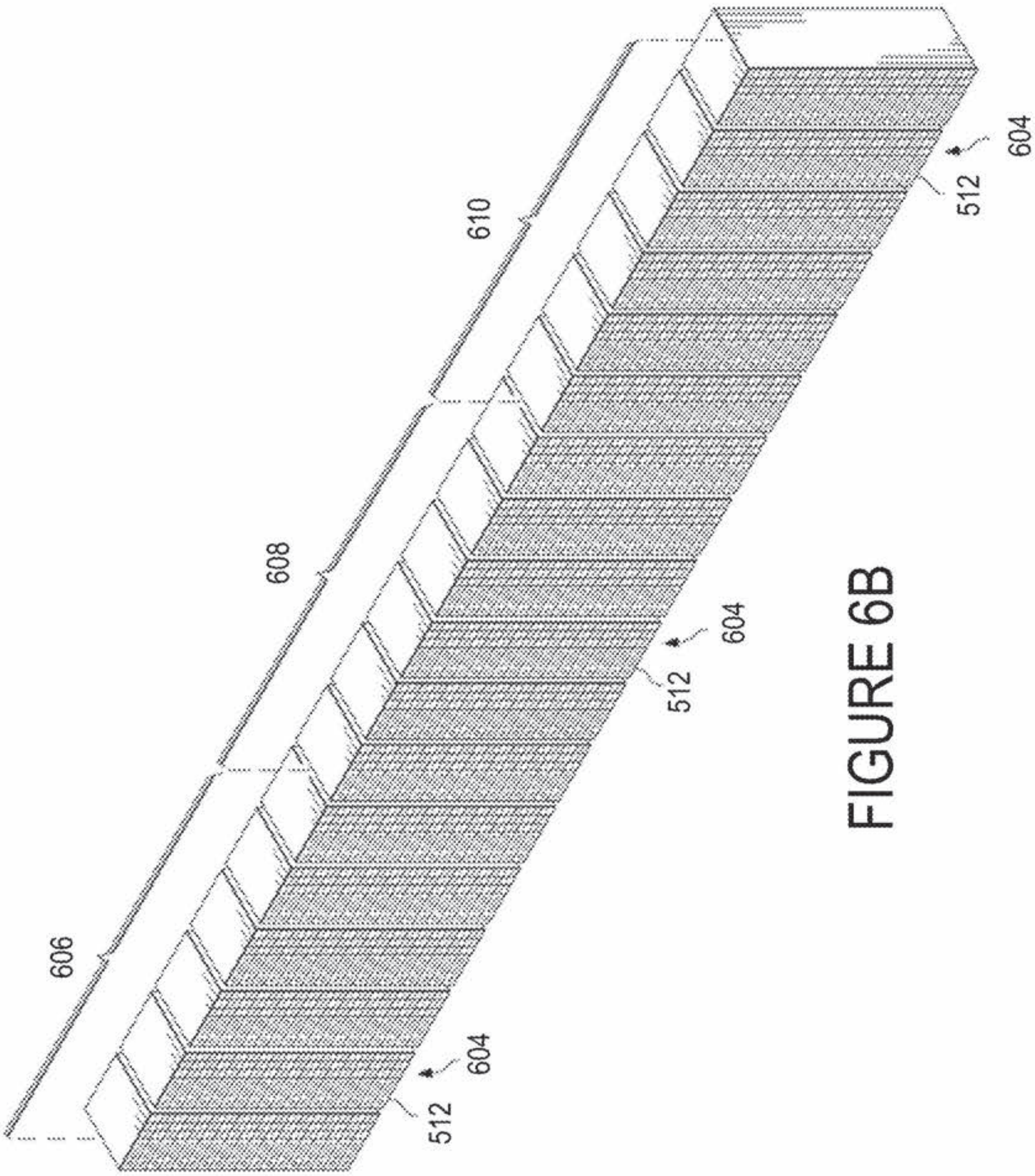

FIGURE 6B

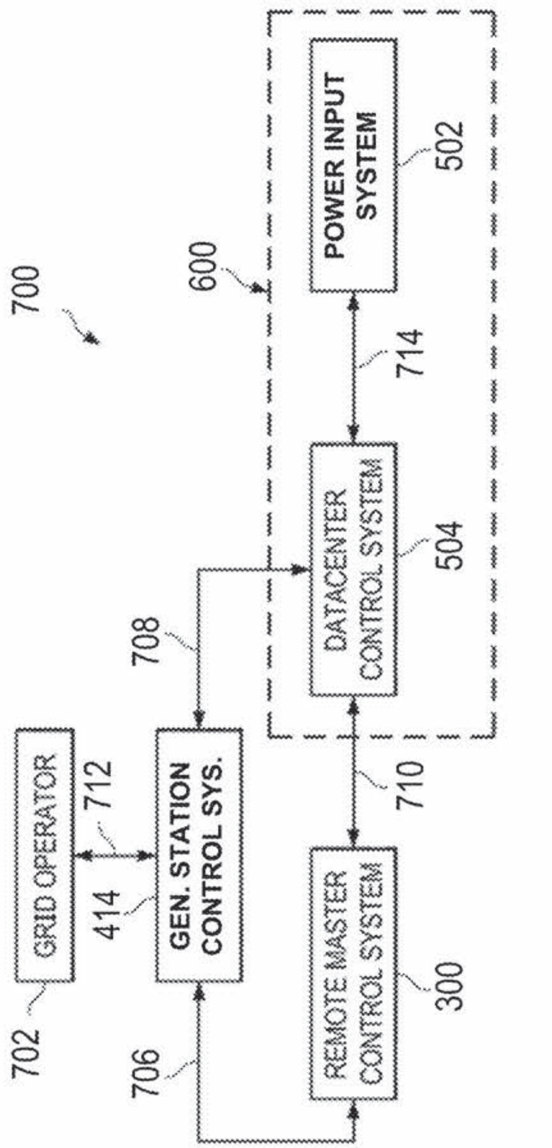
700
600
POWER INPUT SYSTEM
502
714
DATACENTER CONTROL SYSTEM
504
708
710
GRID OPERATOR
712
414
GEN. STATION CONTROL SYS.
702
706
REMOTE MASTER CONTROL SYSTEM
300

FIGURE 7

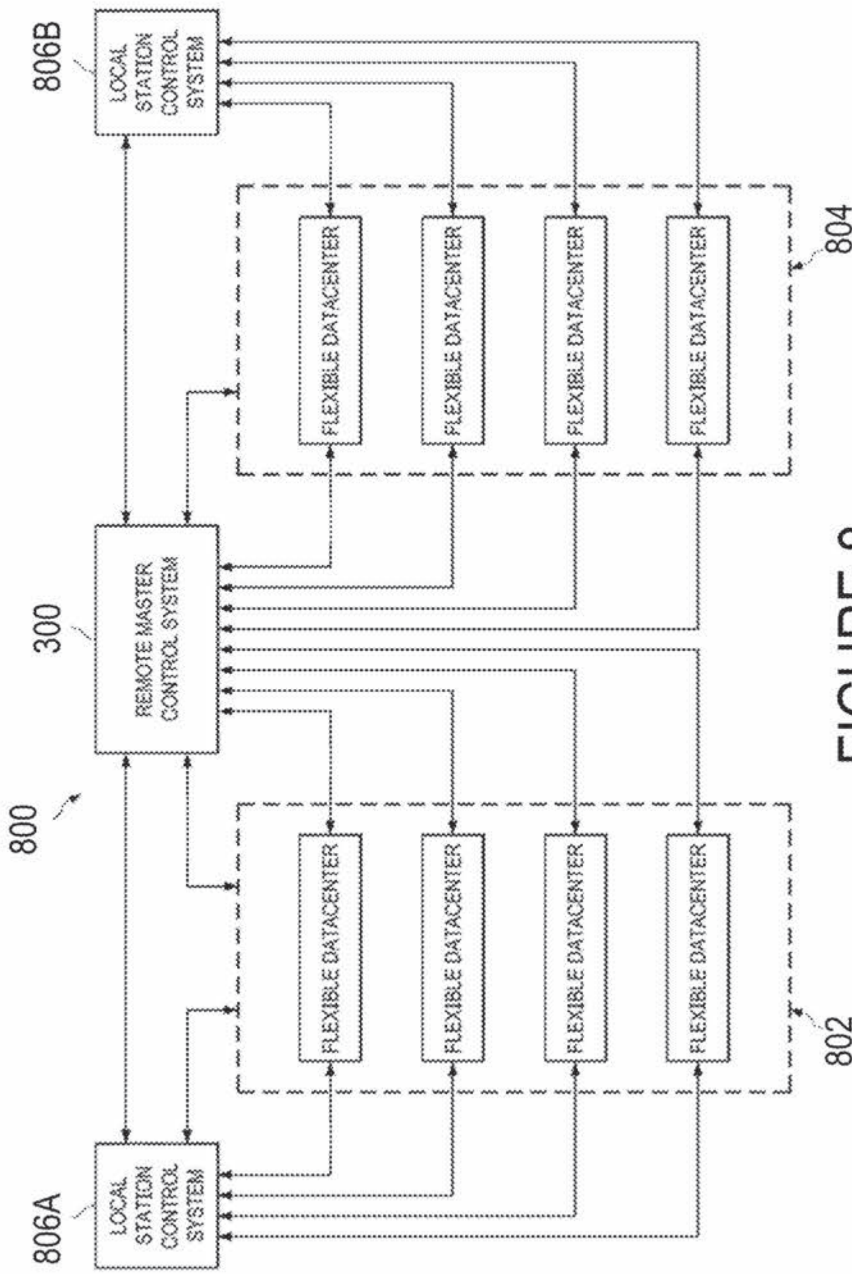
806B
LOCAL STATION CONTROL SYSTEM
300
REMOTE MASTER CONTROL SYSTEM
800
806A
LOCAL STATION CONTROL SYSTEM
FLEXIBLE DATACENTER
804
802

FIGURE 8

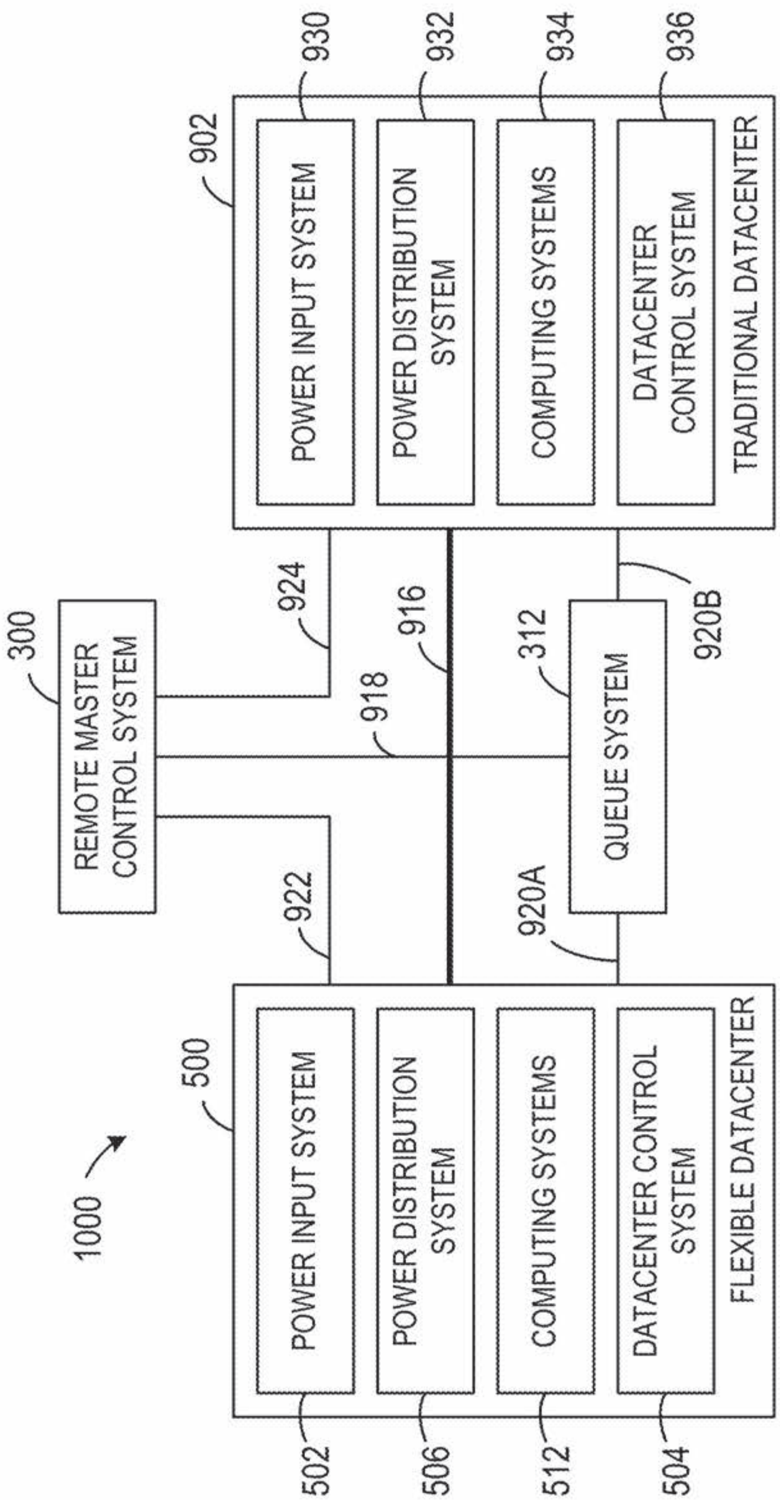
1000
500
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
FLEXIBLE DATACENTER
502
506
512
504
300
REMOTE MASTER CONTROL SYSTEM
922
924
916
918
312
QUEUE SYSTEM
920A
920B
902
POWER INPUT SYSTEM
POWER DISTRIBUTION SYSTEM
COMPUTING SYSTEMS
DATACENTER CONTROL SYSTEM
TRADITIONAL DATACENTER
930
932
934
936

FIGURE 9

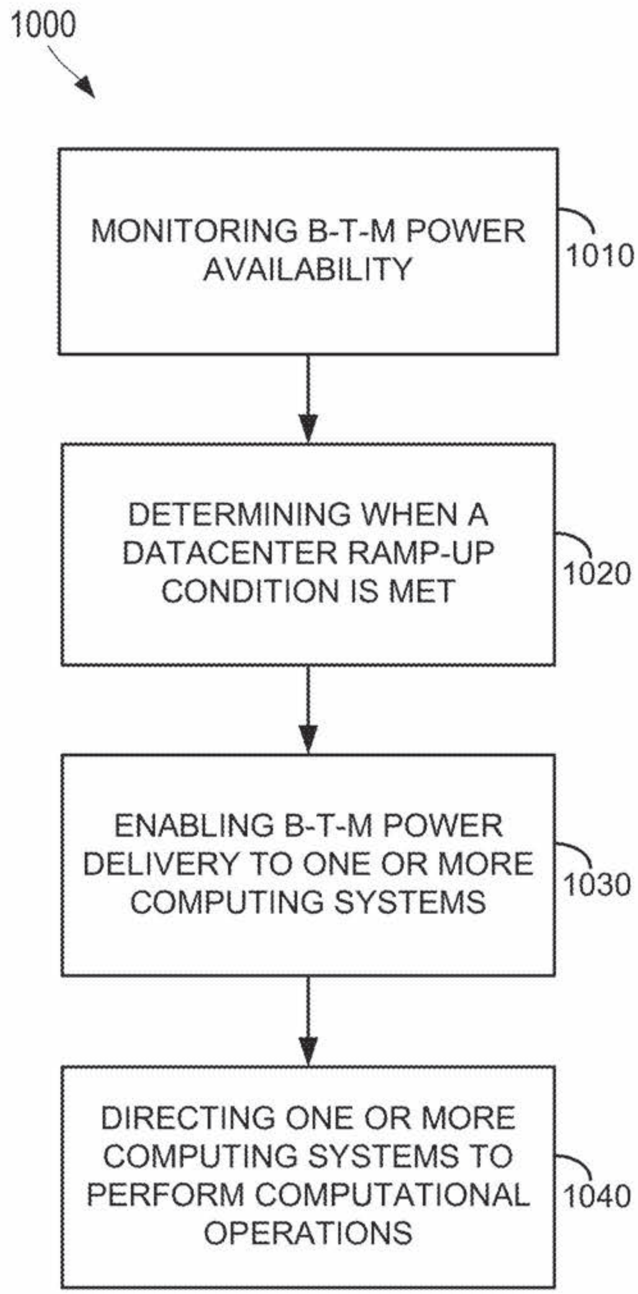
1000
MONITORING B-T-M POWER AVAILABILITY
1010
DETERMINING WHEN A DATACENTER RAMP-UP CONDITION IS MET
1020
ENABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1030
DIRECTING ONE OR MORE COMPUTING SYSTEMS TO PERFORM COMPUTATIONAL OPERATIONS
1040

FIGURE 10A

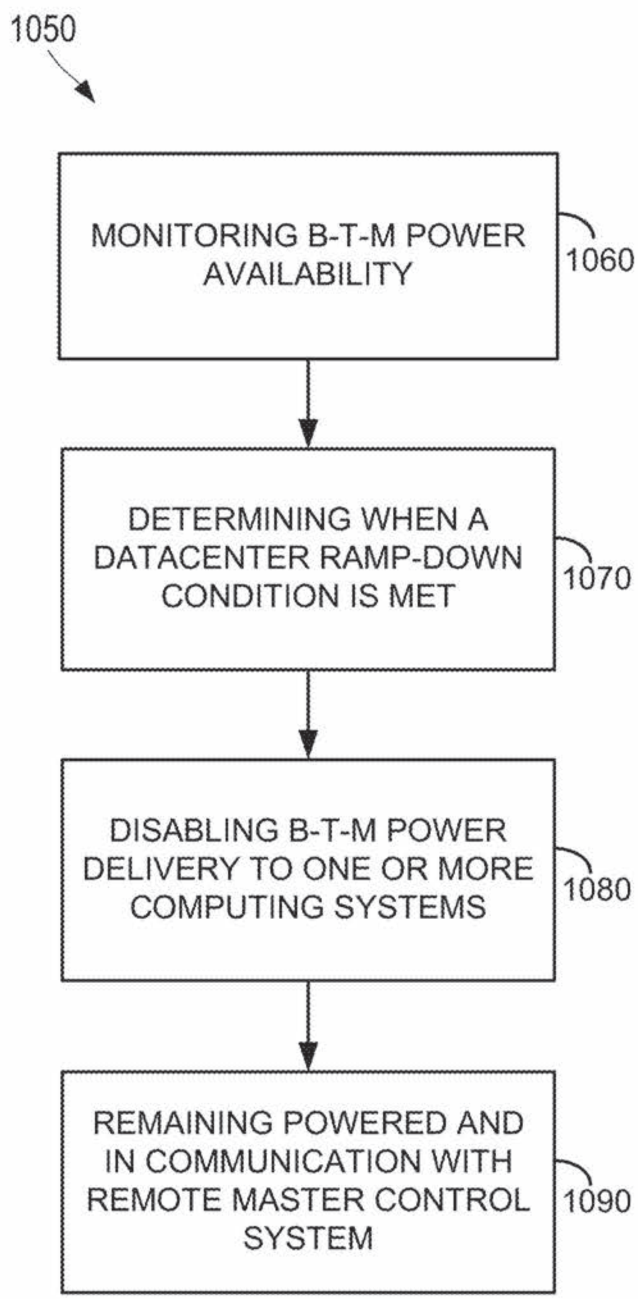
1050
MONITORING B-T-M POWER AVAILABILITY
1060
DETERMINING WHEN A DATACENTER RAMP-DOWN CONDITION IS MET
1070
DISABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
1080
REMAINING POWERED AND IN COMMUNICATION WITH REMOTE MASTER CONTROL SYSTEM
1090

FIGURE 10B

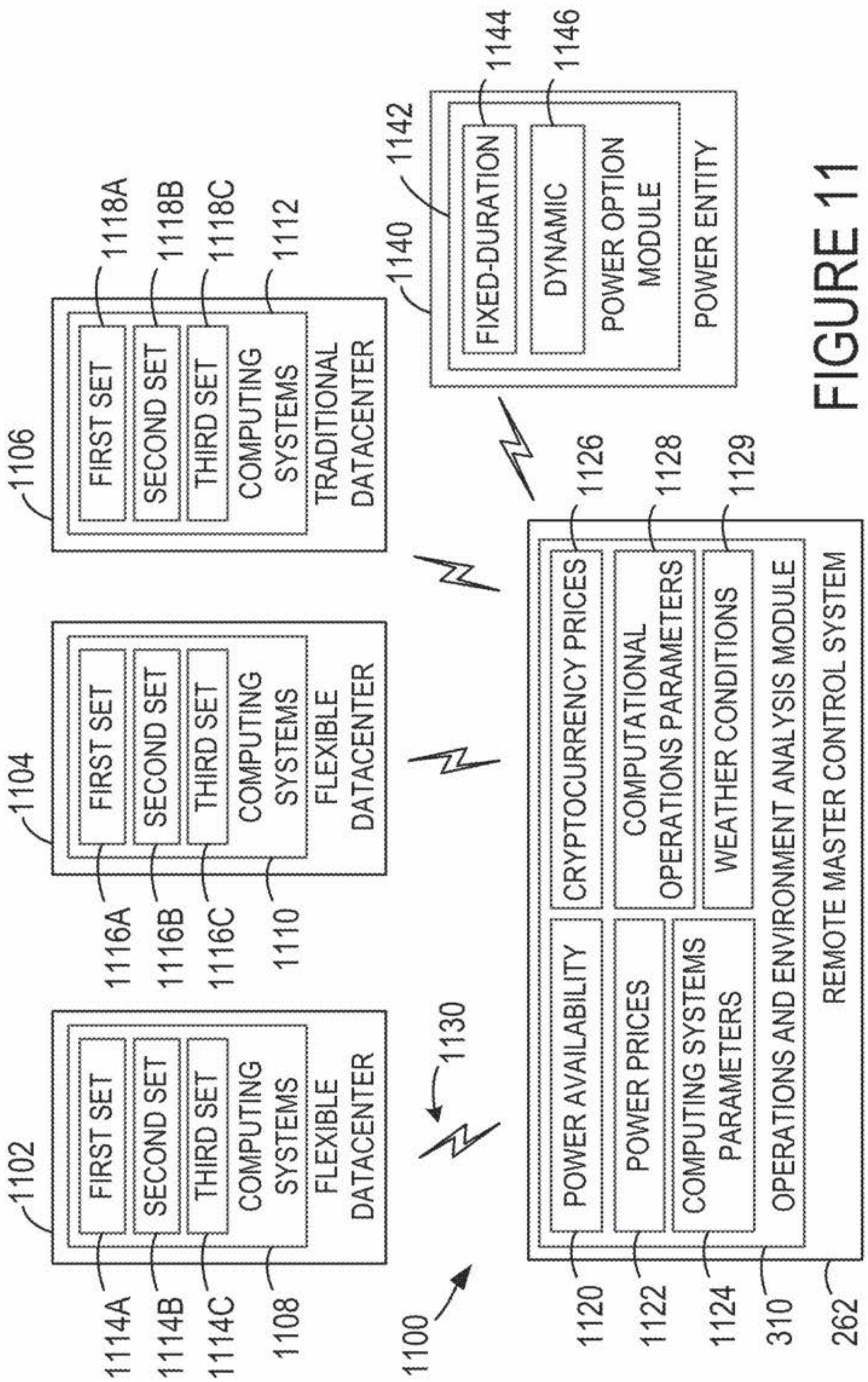
1100
1102
FIRST SET
SECOND SET
THIRD SET
COMPUTING SYSTEMS
FLEXIBLE DATACENTER
1114A
1114B
1114C
1108
1104
FIRST SET
SECOND SET
THIRD SET
COMPUTING SYSTEMS
FLEXIBLE DATACENTER
1116A
1116B
1116C
1110
1106
FIRST SET
SECOND SET
THIRD SET
COMPUTING SYSTEMS
TRADITIONAL DATACENTER
1118A
1118B
1118C
1112
1130
1140
1142
1144
1146
FIXED-DURATION
DYNAMIC
POWER OPTION MODULE
POWER ENTITY
POWER AVAILABILITY
POWER PRICES
COMPUTING SYSTEMS PARAMETERS
CRYPTOCURRENCY PRICES
COMPUTATIONAL OPERATIONS PARAMETERS
WEATHER CONDITIONS
OPERATIONS AND ENVIRONMENT ANALYSIS MODULE
REMOTE MASTER CONTROL SYSTEM
1120
1122
1124
310
262
1126
1128
1129

FIGURE 11

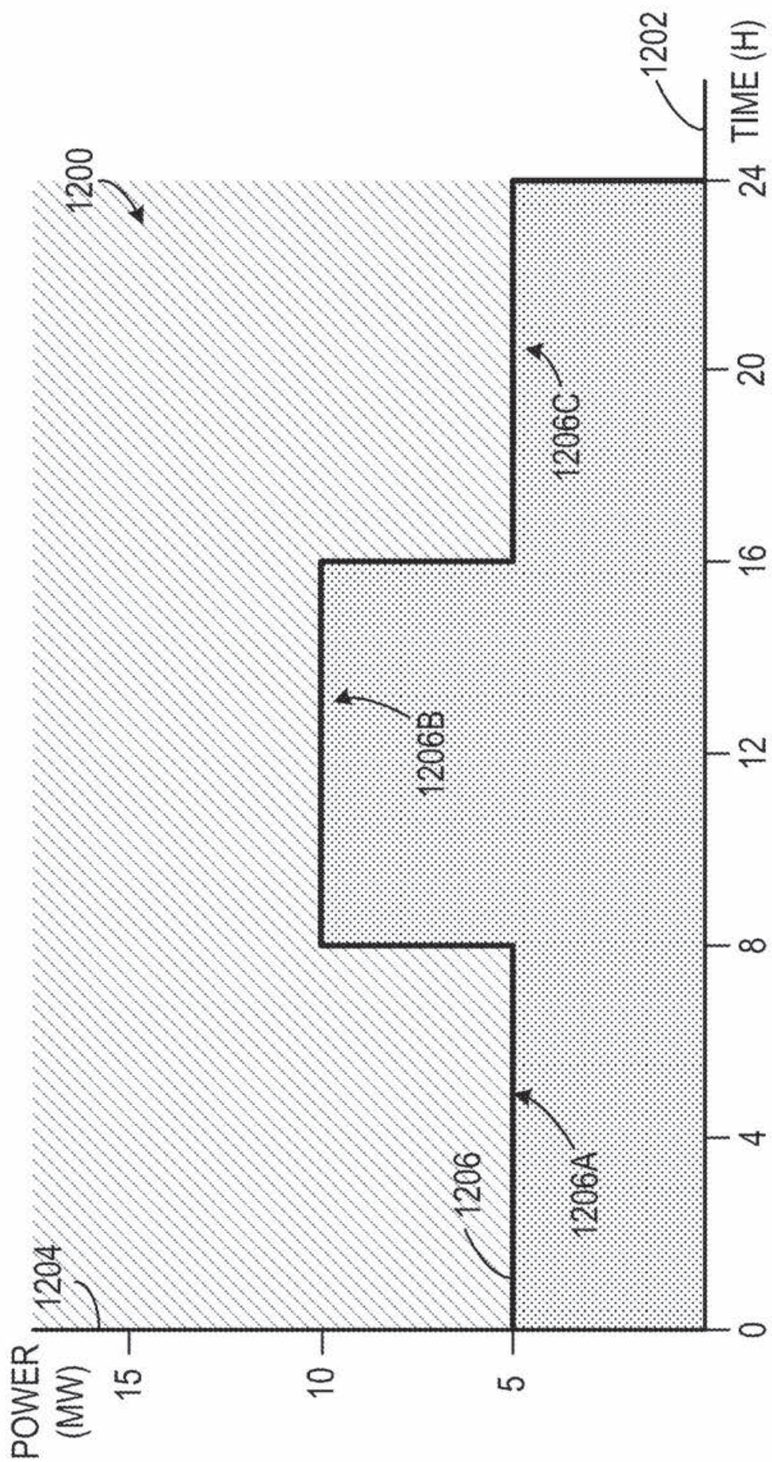
1200
1202
1204
1206
1206A
1206B
1206C
POWER (MW)
15
10
5
0
4
8
12
16
20
24
TIME (H)

FIGURE 12

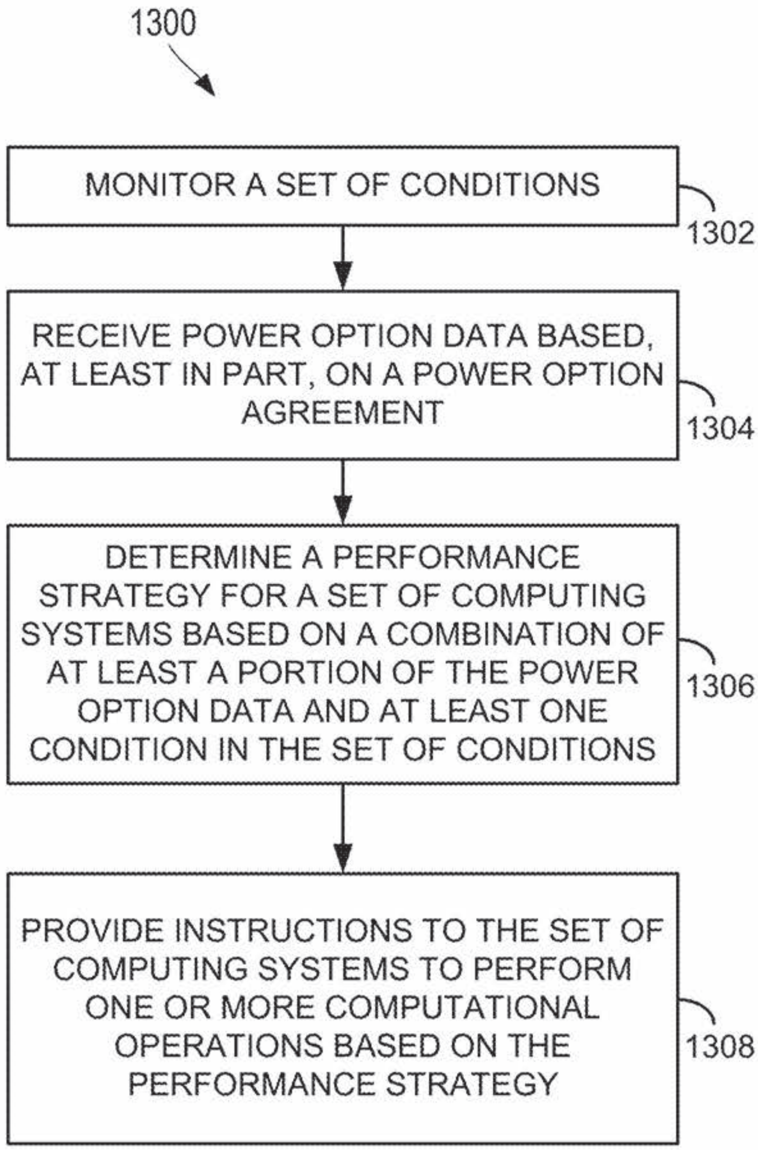
1300
MONITOR A SET OF CONDITIONS
1302
RECEIVE POWER OPTION DATA BASED, AT LEAST IN PART, ON A POWER OPTION AGREEMENT
1304
DETERMINE A PERFORMANCE STRATEGY FOR A SET OF COMPUTING SYSTEMS BASED ON A COMBINATION OF AT LEAST A PORTION OF THE POWER OPTION DATA AND AT LEAST ONE CONDITION IN THE SET OF CONDITIONS
1306
PROVIDE INSTRUCTIONS TO THE SET OF COMPUTING SYSTEMS TO PERFORM ONE OR MORE COMPUTATIONAL OPERATIONS BASED ON THE PERFORMANCE STRATEGY
1308

FIGURE 13

Case 1:21-cv-... Document 10... Fi... PageID #: 2129

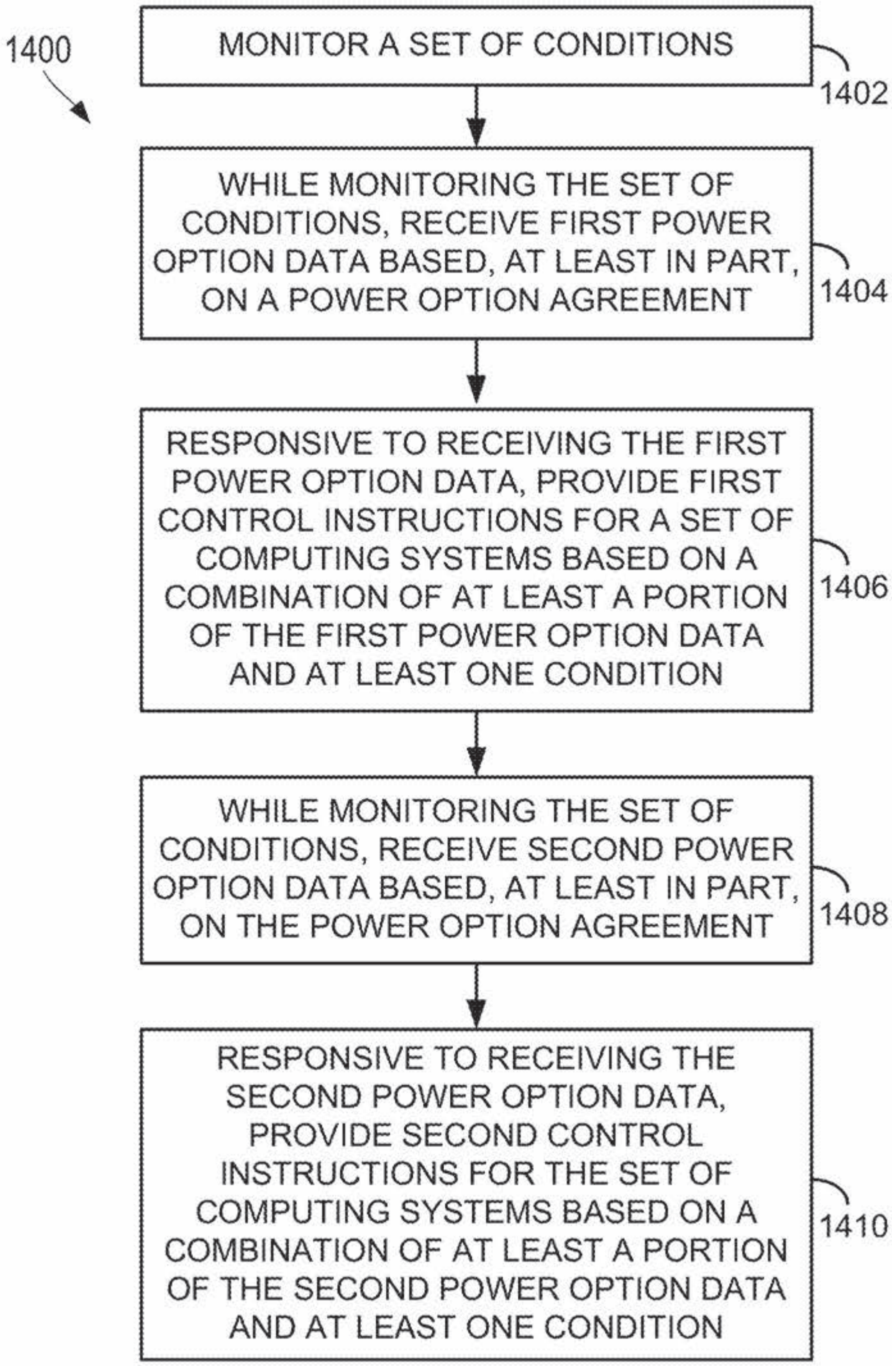

FIGURE 14

METHODS AND SYSTEMS FOR ADJUSTING POWER CONSUMPTION BASED ON A FIXED-DURATION POWER OPTION AGREEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Patent Application No. 62/927,119, filed Oct. 28, 2019, the entire contents of which are herein incorporated by reference.

FIELD

This specification relates to power consumption adjustments when using grid power and/or intermittent behind-the-meter power.

BACKGROUND

"Electrical grid" or "grid," as used herein, refers to a Wide Area Synchronous Grid (also known as an Interconnection), and is a regional scale or greater electric power grid that that operates at a synchronized frequency and is electrically tied together during normal system conditions. An electrical grid delivers electricity from generation stations to consumers. An electrical grid includes: (i) generation stations that produce electrical power at large scales for delivery through the grid, (ii) high voltage transmission lines that carry that power from the generation stations to demand centers, and (iii) distribution networks carry that power to individual customers.

FIG. **1** illustrates a typical electrical grid, such as a North American Interconnection or the synchronous grid of Continental Europe (formerly known as the UCTE grid). The electrical grid of FIG. **1** can be described with respect to the various segments that make up the grid.

A generation segment **102** includes one or more generation stations that produce utility-scale electricity (typically >50 MW), such as a nuclear plant **102***a*, a coal plant **102***b*, a wind power station (i.e., wind farm) **102***c*, and/or a photovoltaic power station (i.e., a solar farm) **102***d*. Generation stations are differentiated from building-mounted and other decentralized or local wind or solar power applications because they supply power at the utility level and scale (>50 MW), rather than to a local user or users. The primary purpose of generation stations is to produce power for distribution through the grid, and in exchange for payment for the supplied electricity. Each of the generation stations **102***a-d* includes power generation equipment **102***e-h*, respectively, typically capable of supply utility-scale power (>50 MW). For example, the power generation equipment **102***g* at wind power station **102***c* includes wind turbines, and the power generation equipment **102***h* at photovoltaic power station **102***d* includes photovoltaic panels.

Each of the generation stations **102***a-d* may further include station electrical equipment **102***i*-**1** respectively. Station electrical equipment **102***i*-**1** are each illustrated in FIG. **1** as distinct elements for simplified illustrative purposes only and may, alternatively or additionally, be distributed throughout the power generation equipment, **102***e-h*, respectively. For example, at wind power station **102***c*, each wind turbine may include transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each wind turbine may be collected by distribution lines along strings of wind turbines and move through collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the wind power station **102***c*. Similarly, at photovoltaic power station **102***d*, individual photovoltaic panels and/or arrays of photovoltaic panels may include inverters, transformers, frequency converters, power converters, and/or electrical filters. Energy generated at each photovoltaic panel and/or array may be collected by distribution lines along the photovoltaic panels and move through collectors, switches, transformers, frequency converters, power converters, electrical filters, and/or other station electrical equipment before leaving the photovoltaic power station **102***d*.

Each generation station **102***a-d* may produce AC or DC electrical current which is then typically stepped up to a higher AC voltage before leaving the respective generation station. For example, wind turbines may typically produce AC electrical energy at 600V to 700V, which may then be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***c*. As another example, photovoltaic arrays may produce DC voltage at 600V to 900V, which is then inverted to AC voltage and may be stepped up to 34.5 kV before leaving the generation station **102***d*. In some cases, the voltage may be stepped up multiple times and to a different voltage before exiting the generation station **102***d*.

Upon exiting the generation segment **102**, electrical power generated at generation stations **102***a-d* passes through a respective Point of Interconnection ("POI") **103** between a generation station (e.g., **102***a-d*) and the rest of the grid. A respective POI **103** represents the point of connection between a generation station's (e.g. **102***a-d*) equipment and a transmission system (e.g., transmission segment **104**) associated with electrical grid. In some cases, at the POI **103**, generated power from generation stations **102***a-d* may be stepped up at transformer systems **103***e-h* to high voltage scales suitable for long-distance transmission along transmission lines **104***a*. Typically, the generated electrical energy leaving the POI **103** will be at 115 kV AC or above, but in some cases it may be as low as, for example, 69 kV for shorter distance transmissions along transmission lines **104***a*. Each of transformer systems **103***e-h* may be a single transformer or may be multiple transformers operating in parallel or series and may be co-located or located in geographically distinct locations. Each of the transformer systems **103***e-h* may include substations and other links between the generation stations **102***a-d* and the transmission lines **104***a*.

A key aspect of the POI **103** is that this is where generation-side metering occurs. One or more utility-scale generation-side meters **103***a-d* (e.g., settlement meters) are located at settlement metering points at the respective POI **103** for each generation station **102***a-d*. The utility-scale generation-side meters **103***a-d* measure power supplied from generation stations **102***a-d* into the transmission segment **104** for eventual distribution throughout the grid.

For electricity consumption, the price consumers pay for power distributed through electric power grids is typically composed of, among other costs, Generation, Administration, and Transmission & Distribution ("T&D") costs. T&D costs represent a significant portion of the overall price paid by consumers for electricity. These costs include capital costs (land, equipment, substations, wire, etc.), costs associated with electrical transmission losses, and operation and maintenance costs.

For utility-scale electricity supply, operators of generation stations (e.g., **102***a-d*) are paid a variable market price for the amount of power the operator generates and provides to the grid, which is typically determined via a power purchase agreement (PPA) between the generation station operator and a grid operator. The amount of power the generation station operator generates and provides to the grid is measured by utility-scale generation-side meters (e.g., **103***a-d*) at settlement metering points. As illustrated in FIG. **1**, the utility-scale generation-side meters **103***a-d* are shown on a low side of the transformer systems **103***e-h*), but they may alternatively be located within the transformer systems **103***e-h* or on the high side of the transformer systems **103***e-h*. A key aspect of a utility-scale generation-side meter is that it is able to meter the power supplied from a specific generation station into the grid. As a result, the grid operator can use that information to calculate and process payments for power supplied from the generation station to the grid. That price paid for the power supplied from the generation station is then subject to T&D costs, as well as other costs, in order to determine the price paid by consumers.

After passing through the utility-scale generation-side meters in the POI **103**, the power originally generated at the generation stations **102***a-d* is transmitted onto and along the transmission lines **104***a* in the transmission segment **104**. Typically, the electrical energy is transmitted as AC at 115 kV+ or above, though it may be as low as 69 kV for short transmission distances. In some cases, the transmission segment **104** may include further power conversions to aid in efficiency or stability. For example, transmission segment **104** may include high-voltage DC ("HVDC") portions (along with conversion equipment) to aid in frequency synchronization across portions of the transmission segment **104**. As another example, transmission segment **104** may include transformers to step AC voltage up and then back down to aid in long distance transmission (e.g., 230 kV, 500 kV, 765 kV, etc.).

Power generated at the generation stations **104***a-d* is ultimately destined for use by consumers connected to the grid. Once the energy has been transmitted along the transmission segment **104**, the voltage will be stepped down by transformer systems **105***a-c* in the step down segment **105** so that it can move into the distribution segment **106**.

In the distribution segment **106**, distribution networks **106***a-c* take power that has been stepped down from the transmission lines **104***a* and distribute it to local customers, such as local sub-grids (illustrated at **106***a*), industrial customers, including large EV charging networks (illustrated at **106***b*), and/or residential and retail customers, including individual EV charging stations (illustrated at **106***c*). Customer meters **106***d*, **106***f* measure the power used by each of the grid-connected customers in distribution networks **106***a-c*. Customer meters **106***d* are typically load meters that are unidirectional and measure power use. Some of the local customers in the distribution networks **106***a-d* may have local wind or solar power systems **106***e* owned by the customer. As discussed above, these local customer power systems **106***e* are decentralized and supply power directly to the customer(s). Customers with decentralized wind or solar power systems **106***e* may have customer meters **106***f* that are bidirectional or net-metering meters that can track when the local customer power systems **106***e* produce power in excess of the customer's use, thereby allowing the utility to provide a credit to the customer's monthly electricity bill. Customer meters **106***d*, **106***f* differ from utility-scale generation-side meters (e.g., settlement meters) in at least the following characteristics: design (electro-mechanical or electronic vs current transformer), scale (typically less than 1600 amps vs. typically greater than 50 MW; typically less than 600V vs. typically greater than 14 kV), primary function (use vs. supply metering), economic purpose (credit against use vs payment for power), and location (in a distribution network at point of use vs. at a settlement metering point at a Point of Interconnection between a generation station and a transmission line).

To maintain stability of the grid, the grid operator strives to maintain a balance between the amount of power entering the grid from generation stations (e.g., **102***a-d*) and the amount of grid power used by loads (e.g., customers in the distribution segment **106**). In order to maintain grid stability and manage congestion, grid operators may take steps to reduce the supply of power arriving from generation stations (e.g., **102***a-d*) when necessary (e.g., curtailment). Particularly, grid operators may decrease the market price paid for generated power to dis-incentivize generation stations (e.g., **102***a-d*) from generating and supplying power to the grid. In some cases, the market price may even go negative such that generation station operators must pay for power they allow into the grid. In addition, some situations may arise where grid operators explicitly direct a generation station (e.g., **102***a-d*) to reduce or stop the amount of power the station is supplying to the grid.

Power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and operational directives resulting in reduced or discontinued generation all can have disparate effects on renewal energy generators and can occur multiple times in a day and last for indeterminate periods of time. Curtailment, in particular, is particularly problematic.

According to the National Renewable Energy Laboratory's Technical Report TP-6A20-60983 (March 2014):

> [C]urtailment [is] a reduction in the output of a generator from what it could otherwise produce given available resources (e.g., wind or sunlight), typically on an involuntary basis. Curtailments can result when operators or utilities command wind and solar generators to reduce output to minimize transmission congestion or otherwise manage the system or achieve the optimal mix of resources. Curtailment of wind and solar resources typically occurs because of transmission congestion or lack of transmission access, but it can also occur for reasons such as excess generation during low load periods that could cause baseload generators to reach minimum generation thresholds, because of voltage or interconnection issues, or to maintain frequency requirements, particularly for small, isolated grids. Curtailment is one among many tools to maintain system energy balance, which can also include grid capacity, hydropower and thermal generation, demand response, storage, and institutional changes. Deciding which method to use is primarily a matter of economics and operational practice.
>
> "Curtailment" today does not necessarily mean what it did in the early 2000s. Two separate changes in the electric sector have shaped curtailment practices since that time: the utility-scale deployment of wind power, which has no fuel cost, and the evolution of wholesale power markets. These simultaneous changes have led to new operational challenges but have also expanded the array of market-based tools for addressing them.
>
> Practices vary significantly by region and market design. In places with centrally-organized wholesale power markets and experience with wind power, manual wind energy curtailment processes are increasingly being

replaced by transparent offer-based market mechanisms that base dispatch on economics. Market protocols that dispatch generation based on economics can also result in renewable energy plants generating less than what they could potentially produce with available wind or sunlight. This is often referred to by grid operators by other terms, such as "downward dispatch." In places served primarily by vertically integrated utilities, power purchase agreements (PPAs) between the utility and the wind developer increasingly contain financial provisions for curtailment contingencies.

Some reductions in output are determined by how a wind operator values dispatch versus non-dispatch. Other curtailments of wind are determined by the grid operator in response to potential reliability events. Still other curtailments result from overdevelopment of wind power in transmission-constrained areas.

Dispatch below maximum output (curtailment) can be more of an issue for wind and solar generators than it is for fossil generation units because of differences in their cost structures. The economics of wind and solar generation depend on the ability to generate electricity whenever there is sufficient sunlight or wind to power their facilities.

Because wind and solar generators have substantial capital costs but no fuel costs (i.e., minimal variable costs), maximizing output improves their ability to recover capital costs. In contrast, fossil generators have higher variable costs, such as fuel costs. Avoiding these costs can, depending on the economics of a specific generator, to some degree reduce the financial impact of curtailment, especially if the generator's capital costs are included in a utility's rate base.

Curtailment may result in available energy being wasted because solar and wind operators have zero variable cost (which may not be true to the same extent for fossil generation units which can simply reduce the amount of fuel that is being used). With wind generation, in particular, it may also take some time for a wind farm to become fully operational following curtailment. As such, until the time that the wind farm is fully operational, the wind farm may not be operating with optimum efficiency and/or may not be able to provide power to the grid.

SUMMARY

In an example, a system includes a set of computing systems. The set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and, while monitoring the set of conditions, receive first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The control system is further configured to provide first control instructions for the set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions responsive to receiving the first power option data. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The control system is also configured to, while monitoring the set of conditions, receive second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. Responsive to receiving the second power option data, the control system is configured to provide second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and wherein the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In another example, a method involves monitoring, at a computing system, a set of conditions, and while monitoring the set of conditions, receiving first power option data based, at least in part, on a power option agreement. The first power option data specify a first minimum power threshold associated with a first time interval. The method further involves, responsive to receiving the first power option data, providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions. The first control instructions comprises a first power consumption target for the set of computing systems for the first time interval, and the first power consumption target is equal to or greater than the first minimum power threshold associated with the first time interval. The method further involves, while monitoring the set of conditions, receiving second power option data based, at least in part, on the power option agreement. The second power option data specify a second minimum power threshold associated with a second time interval. The method also involves, responsive to receiving the second power option data, providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions. The second control instructions comprises a second power consumption target for the set of computing systems for the second time interval, and the second power consumption target is equal to or greater than the second minimum power threshold associated with the second time interval.

In yet another example, a system is provided. The system includes a set of computing systems, where the set of computing systems is configured to perform computational operations using power from a power grid. The system also includes a control system configured to monitor a set of conditions and receive power option data based, at least in part, on a power option agreement. The power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, where each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals. The control system is further configured to, responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, where each power consumption target is equal to or greater than the minimum power threshold associated with each time interval. The control system is also configured to provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

In a further example, non-transitory computer-readable medium is described that is configured to store instructions,

that when executed by a computing system, causes the computing system to perform operations consistent with the method steps described above.

Other aspects of the present invention will be apparent from the following description and claims.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** shows a typical electrical grid.

FIG. **2** shows a behind-the-meter arrangement with optional grid power, including one or more flexible datacenters, according to one or more example embodiments.

FIG. **3** shows a block diagram of a remote master control system, according to one or more example embodiments.

FIG. **4** a block diagram of a generation station, according to one or more example embodiments.

FIG. **5** shows a block diagram of a flexible datacenter, according to one or more example embodiments.

FIG. **6**A shows a structural arrangement of a flexible datacenter, according to one or more example embodiments.

FIG. **6**B shows a set of computing systems arranged in a straight configuration, according to one or more example embodiments.

FIG. **7** shows a control distribution system for a flexible datacenter, according to one or more example embodiments.

FIG. **8** shows a control distribution system for a fleet of flexible datacenters, according to one or more example embodiments.

FIG. **9** shows a queue distribution system for a traditional datacenter and a flexible datacenter, according to one or more example embodiments.

FIG. **10**A shows a method of dynamic power consumption at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **10**B shows a method of dynamic power delivery at a flexible datacenter using behind-the-meter power, according to one or more example embodiments.

FIG. **11** shows a block diagram of a system for implementing power consumption adjustments based on a power option agreement, according to one or more embodiments.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments.

FIG. **13** shows a method for implementing power consumption adjustments based on a fixed-duration power option agreement, according to one or more embodiments.

FIG. **14** shows a method for implementing power consumption adjustments based on a dynamic power option agreement, according to one or more embodiments.

DETAILED DESCRIPTION

Disclosed examples will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all of the disclosed examples are shown. Different examples may be described and should not be construed as limited to the examples set forth herein.

As discussed above, the market price paid to generation stations for supplying power to the grid often fluctuates due to various factors, including the need to maintain grid stability and based on current demand and usage by connected loads in distribution networks. Due to these factors, situations can arise where generation stations are offered substantially lower prices to deter an over-supply of power to the grid. Although these situations typically exist temporarily, generation stations are sometimes forced to either sell power to the grid at the much lower prices or adjust operations to decrease the amount of power generated. Furthermore, some situations may even require generation stations to incur costs in order to offload power to the grid or to shut down generation temporarily.

The volatility in the market price offered for power supplied to the grid can be especially problematic for some types of generation stations. In particular, wind farms and some other types of renewable resource power producers may lack the ability to quickly adjust operations in response to changes in the market price offered for supplying power to the grid. As a result, power generation and management at some generation stations can be inefficient, which can frequently result in power being sold to the grid at low or negative prices. In some situations, a generation station may even opt to halt power generation temporarily to avoid such unfavorable pricing. As such, the time required to halt and to restart the power generation at a generation station can reduce the generation station's ability to take advantage of rising market prices for power supplied to the grid.

Example embodiments provided herein aim to assist generation stations in managing power generation operations and avoid unfavorable power pricing situations like those described above. In particular, example embodiments may involve providing a load that is positioned behind-the-meter ("BTM") and enabling the load to utilize power received behind-the-meter at a generation station in a timely manner. As a general rule of thumb, BTM power is not subject to traditional T&D costs.

For purposes herein, a generation station is considered to be configured for the primary purpose of generating utility-scale power for supply to the electrical grid (e.g., a Wide Area Synchronous Grid or a North American Interconnect).

In one embodiment, equipment located behind-the-meter ("BTM equipment") is equipment that is electrically connected to a generation station's power generation equipment behind (i.e., prior to) the generation station's POI with an electrical grid.

In one embodiment, behind-the-meter power ("BTM power") is electrical power produced by a generation station's power generation equipment and utilized behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM equipment receives power from the generation station, but the power received by the BTM equipment from the generation station has not passed through the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that is subject to metering by a utility-scale generation-side meter (e.g., settlement meter), and the BTM power is utilized before being metered at the utility-scale generation-side meter. In one embodiment, the utility-scale generation-side meter for the generation station is located at the generation station's POI. In another embodiment, the utility-scale generation-side meter for the generation station is at a location other than the POI for the generation station—for example, a substation between the generation station and the generation station's POI.

In another embodiment, equipment may be considered behind-the-meter if it is electrically connected to a generation station that supplies power to a grid, and the BTM equipment receives power from the generation station that is not subject to T&D charges, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station that supplies power to a grid, and the BTM power is not subject to T&D charges before being used by electrical equipment, but power received from the grid that is supplied by the generation station is subject to T&D charges.

In another embodiment, equipment may be considered behind-the-meter if the BTM equipment receives power generated from the generation station and that received power is not routed through the electrical grid before being delivered to the BTM equipment.

In another embodiment, power may be considered behind-the-meter if it is electrical power produced at a generation station, and BTM equipment receives that generated power, and that generated power received by the BTM equipment is not routed through the electrical grid before being delivered to the BTM equipment.

For purposes herein, BTM equipment may also be referred to as a behind-the-meter load ("BTM load") when the BTM equipment is actively consuming BTM power.

Beneficially, where BTM power is not subject to traditional T&D costs, a wind farm or other type of generation station can be connected to BTM loads which can allow the generation station to selectively avoid the adverse or less-than optimal cost structure occasionally associated with supplying power to the grid by shunting generated power to the BTM load.

An arrangement that positions and connects a BTM load to a generation station can offer several advantages. In such arrangements, the generation station may selectively choose whether to supply power to the grid or to the BTM load, or both. The operator of a BTM load may pay to utilize BTM power at a cost less than that charged through a consumer meter (e.g., **106***d*, **1060** located at a distribution network (e.g., **106***a-c*) receiving power from the grid. The operator of a BTM load may additionally or alternatively charge less than the market rate to consume excess power generated at the generation station during curtailment. As a result, the generation station may direct generated power based on the "best" price that the generation station can receive during a given time frame, and/or the lowest cost the generation station may incur from negative market pricing during curtailment. The "best" price may be the highest price that the generation station may receive for its generated power during a given duration, but can also differ within embodiments and may depend on various factors, such as a prior PPA.

In one example, by having a behind-the-meter option available, a generation station may transition from supplying all generated power to the grid to supplying some or all generated power to one or more BTM loads when the market price paid for power by grid operators drops below a predefined threshold (e.g., the price that the operator of the BTM load is willing to pay the generation station for power). Thus, by having an alternative option for power consumption (i.e., one or more BTM loads), the generation station can selectively utilize the different options to maximize the price received for generated power. In addition, the generation station may also utilize a BTM load to avoid or reduce the economic impact in situations when supplying power to the grid would result in the generation station incurring a net cost.

Providing BTM power to a load can also benefit the BTM load operator. A BTM load may be able to receive and utilize BTM power received from the generation station at a cost that is lower than the cost for power from the grid (e.g., at a customer meter **106***d*, **1060**. This is primarily due to the avoidance (or significant reduction) in T&D costs and the market effects of curtailment. As indicated above, the generation station may be willing to divert generated power to the BTM load rather than supplying the grid due to changing market conditions, or during maintenance periods, or for other non-market conditions. Thus, some situations may arise where the generation station offers power to the BTM load at a price that is substantially lower than the price available on the grid. Furthermore, in some situations, the BTM load may even be able to obtain and utilize BTM power from a generation station at no cost or even at negative pricing since the generation station may rather supply the BTM load with generated power during a given time range instead of paying a higher price for the grid to take the power or modifying operations to decrease power output.

Another example of cost-effective use of BTM power is when the generation station **202** is selling power to the grid at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price the generation station **202** would have to pay to the grid power to offload generation's station **202** generated power. Advantageously, one or more flexible datacenters **220** may take the generated power behind-the-meter, thereby allowing the generation station **202** to produce and obtain the production tax credit, while selling less power to the grid at the negative price.

Another example of cost-effective behind-the-meter power is when the generation station **202** is selling power to the grid at a negative price because the grid is oversupplied and/or the generation station **202** is instructed to stand down and stop producing altogether. A grid operator may select and direct certain generation stations to go offline and stop supplying power to the grid. Advantageously, one or more flexible datacenters may be used to take power behind-the-meter, thereby allowing the generation station **202** to stop supplying power to the grid, but still stay online and make productive use of the power generated.

Another example of beneficial behind-the-meter power use is when the generation station **202** is producing power that is, with reference to the grid, unstable, out of phase, or at the wrong frequency, or the grid is already unstable, out of phase, or at the wrong frequency. A grid operator may select certain generation stations to go either offline and stop producing power, or to take corrective action with respect to the grid power stability, phase, or frequency. Advantageously, one or more flexible datacenters **220** may be used to selectively consume power behind-the-meter, thereby allowing the generation station **202** to stop providing power to the grid and/or provide corrective feedback to the grid.

Another example of beneficial behind-the-meter power use is that cost-effective behind-the-meter power availability may occur when the generation station **202** is starting up or testing. Individual equipment in the power generation equipment **210** may be routinely offline for installation, maintenance, and/or service and the individual units must be tested prior to coming online as part of overall power generation equipment **210**. During such testing or maintenance time, one or more flexible datacenters may be intermittently

powered by the one or more units of the power generation equipment **210** that are offline from the overall power generation equipment **210**.

Another example of beneficial behind-the-meter power use is that datacenter control systems at the flexible datacenters **220** may quickly ramp up and ramp down power consumption by computing systems in the flexible datacenters **220** based on power availability from the generation station **202**. For instance, if the grid requires additional power and signals the demand via a higher local price for power, the generation station **202** can supply the grid with power nearly instantly by having active flexible datacenters **220** quickly ramp down and turn off computing systems (or switch to a stored energy source), thereby reducing an active BTM load.

Another example of beneficial behind-the-meter power use is in new photovoltaic generation stations **202**. For example, it is common to design and build new photovoltaic generation stations with a surplus of power capacity to account for degradation in efficiency of the photovoltaic panels over the life of the generation stations. Excess power availability at the generation station can occur when there is excess local power generation and/or low grid demand. In high incident sunlight situations, a photovoltaic generation station **202** may generate more power than the intended capacity of generation station **202**. In such situations, a photovoltaic generation station **202** may have to take steps to protect its equipment from damage, which may include taking one or more photovoltaic panels offline or shunting their voltage to dummy loads or the ground. Advantageously, one or more flexible datacenters (e.g., the flexible datacenters **220**) may take power behind-the-meter at the Generations Station **202**, thereby allowing the generation station **202** to operate the power generation equipment **210** within operating ranges while the flexible datacenters **220** receive BTM power without transmission or distribution costs.

Thus, for at least the reasons described herein, arrangements that involves providing a BTM load as an alternative option for a generation station to direct its generated power to can serve as a mutually beneficial relationship in which both the generation station and the BTM load can economically benefit. The above-noted examples of beneficial use of BTM power are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as benefits to unutilized BTM power capacity, BTM power pricing, or BTM power consumption.

Within example embodiments described herein, various types of utility-scale power producers may operate as generation stations **202** that are capable of supplying power to one or more loads behind-the-meter. For instance, renewable energy sources (e.g., wind, solar, hydroelectric, wave, water current, tidal), fossil fuel power generation sources (coal, natural gas), and other types of power producers (e.g., nuclear power) may be positioned in an arrangement that enables the intermittent supply of generated power behind-the-meter to one or more BTM loads. One of ordinary skill in the art will recognize that the generation station **202** may vary based on an application or design in accordance with one or more example embodiments.

In addition, the particular arrangement (e.g., connections) between the generation station and one or more BTM loads can vary within examples. In one embodiment, a generation station may be positioned in an arrangement wherein the generation station selectively supplies power to the grid and/or to one or more BTM loads. As such, power cost-analysis and other factors (e.g., predicted weather conditions, contractual obligations, etc.) may be used by the generation station, a BTM load control system, a remote master control system, or some other system or enterprise, to selectively output power to either the grid or to one or more BTM loads in a manner that maximizes revenue to the generation station. In such an arrangement, the generation station may also be able to supply both the grid and one or more BTM loads simultaneously. In some instances, the arrangement may be configured to allow dynamic manipulation of the percentage of the overall generated power that is supplied to each option at a given time. For example, in some time periods, the generation station may supply no power to the BTM load.

In addition, the type of loads that are positioned behind-the-meter can vary within example embodiments. In general, a load that is behind-the-meter may correspond to any type of load capable of receiving and utilizing power behind-the-meter from a generation station. Some examples of loads include, but are not limited to, datacenters and electric vehicle (EV) charging stations.

Preferred BTM loads are loads that can be subject to intermittent power supply because BTM power may be available intermittently. In some instances, the generation station may generate power intermittently. For example, wind power station **102***c* and/or photovoltaic power station **102***d* may only generate power when resource are available or favorable. Additionally or alternatively, BTM power availability at a generation station may only be available intermittently due to power market fluctuations, power system conditions (e.g., power factor fluctuation or generation station startup and testing), and/or operational directives from grid operators or generation station operators.

Some example embodiments of BTM loads described herein involve using one or more computing systems to serve as a BTM load at a generation station. In particular, the computing system or computing systems may receive power behind-the-meter from the generation station to perform various computational operations, such as processing or storing information, performing calculations, mining for cryptocurrencies, supporting blockchain ledgers, and/or executing applications, etc.

Multiple computing systems positioned behind-the-meter may operate as part of a "flexible" datacenter that is configured to operate only intermittently and to receive and utilize BTM power to carry out various computational operations similar to a traditional datacenter. In particular, the flexible datacenter may include computing systems and other components (e.g., support infrastructure, a control system) configured to utilize BTM power from one or more generation stations. The flexible datacenter may be configured to use particular load ramping abilities (e.g., quickly increase or decrease power usage) to effectively operate during intermittent periods of time when power is available from a generation station and supplied to the flexible datacenter behind-the-meter, such as during situations when supplying generated power to the grid is not favorable for the generation station.

In some instances, the amount of power consumed by the computing systems at a flexible datacenter can be ramped up and down quickly, and potentially with high granularity (i.e., the load can be changed in small increments if desired). This may be done based on monitored power system conditions or other information analyses as discussed herein. As recited above, this can enable a generation station to avoid negative power market pricing and to respond quickly to grid direc-

tives. And by extension, the flexible datacenter may obtain BTM power at a price lower than the cost for power from the grid.

Various types of computing systems can provide granular power ramping. Preferably, the computing systems can perform computational tasks that are immune to, or not substantially hindered by, frequent interruptions or slow-downs in processing as the computing systems ramp down or up. In some embodiments, a control system may be used to activate or de-activate one or more computing systems in an array of computing systems. For example, the control system may provide control instructions to one or more blockchain miners (e.g., a group of blockchain miners), including instructions for powering on or off, adjusting frequency of computing systems performing operations (e.g., adjusting the processing frequency), adjusting the quantity of operations being performed, and when to operate within a low power mode (if available).

Within examples, a control system may correspond to a specialized computing system or may be a computing system within a datacenter serving in the role of the control system. The location of the control system can vary within examples as well. For instance, the control system may be located at a datacenter or physically separate from the datacenter. In some examples, the control system may be part of a network of control systems that manage computational operations, power consumption, and other aspects of a fleet of datacenters. The fleet of datacenters may include one or more traditional datacenters and/or flexible datacenters.

Some embodiments may involve using one or more control systems to direct time-insensitive (e.g., interruptible) computational tasks to computational hardware, such as central processing units (CPUs) and graphics processing units (GPUs), sited behind the meter, while other hardware is sited in front of the meter (i.e., consuming metered grid power via a customer meter (e.g., **106***d*, **1060**) and possibly remote from the behind-the-meter hardware. As such, parallel computing processes, such as Monte Carlo simulations, batch processing of financial transactions, graphics rendering, machine learning, neural network processing, queued operations, and oil and gas field simulation models, are good candidates for such interruptible computational operations.

FIG. **2** shows a behind-the-meter arrangement with optional grid-power, including one or more flexible datacenters, according to one or more example embodiments. Dark arrows illustrate a typical power delivery direction. Consistent with FIG. **1**, the arrangement illustrates a generation station **202** in the generation segment **102** of a Wide-Area Synchronous Grid. The generation station **202** supplies utility-scale power (typically >50 MW) via a generation power connection **250** to the Point of Interconnection **103** between the generation station **202** and the rest of the grid. Typically, the power supplied on connection **250** may be at 34.5 kV AC, but it may be higher or lower. Depending on the voltage at connection **250** and the voltage at transmission lines **104***a*, a transformer system **203** may step up the power supplied from the generation station **202** to high voltage (e.g., 115 kV+AC) for transmission over connection **252** and onto transmission lines **104***a* of transmission segment **104**. Grid power carried on the transmission segment **104** may be from generation station **202** as well as other generation stations (not shown). Also consistent with FIG. **1**, grid power is consumed at one or more distribution networks, including example distribution network **206**. Grid power may be taken from the transmission lines **104***a* via connector **254** and stepped down to distribution network voltages (e.g., typically 4 kV to 26 kV AC) and sent into the distribution networks, such as distribution network **206** via distribution line **256**. The power on distribution line **256** may be further stepped down (not shown) before entering individual consumer facilities such as a remote master control system **262** and/or traditional datacenters **260** via customer meters **206**A, which may correspond to customer meters **106***d* in FIG. **1**, or customer meters **106***f* in FIG. **1** if the respective consumer facility includes a local customer power system, such as **106***e* (not shown in FIG. **2**).

Consistent with FIG. **1**, power entering the grid from generation station **202** is metered by a utility-scale generation-side meter. A utility-scale generation-side meter **253** is shown on the low side of transformer system **203** and an alternative location is shown as **253**A on the high side of transformer system **203**. Both locations may be considered settlement metering points for the generation station **202** at the POI **103**. Alternatively, a utility-scale generation-side meter for the generation station **202** may be located at another location consistent with the descriptions of such meters provided herein.

Generation station **202** includes power generation equipment **210**, which may include, as examples, wind turbines and/or photovoltaic panels. Power generation equipment **210** may further include other electrical equipment, including but not limited to switches, busses, collectors, inverters, and power unit transformers (e.g., transformers in wind turbines).

As illustrated in FIG. **2**, generation station **202** is configured to connect with BTM equipment which may function as BTM loads. In the illustrated embodiment of FIG. **2**, the BTM equipment includes flexible datacenters **220**. Various configurations to supply BTM power to flexible datacenters **220** within the arrangement of FIG. **2** are described herein.

In one configuration, generated power may travel from the power generation equipment **210** over one or more connectors **230**A, **230**B to one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **230**A, **230**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **230**B is shown with an open switch, and connector **230**A is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used in various embodiments when BTM power is supplied without significant power conversion to BTM loads.

In various configurations, the busses **240**A and **240**B may be separated by an open switch **240**C or combined into a common bus by a closed switch **240**C.

In another configuration, generated power may travel from the power generation equipment **210** to the high side of a local step-down transformer **214**. The generated power may then travel from the low side of the local step-down transformer **214** over one or more connectors **232**A, **232**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **232**A, **232**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, connector **232**A is shown with an open switch, and connector **232**B is shown with a closed switch, but either or both may be reversed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the power generation equipment **210**, but the generated power must be stepped down prior to use at the BTM loads.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of a local step-up transformer **212**. The generated power may

then travel from the high side of the local step-up transformer **212** over one or more connectors **234**A, **234**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **234**A, **234**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **234**A, **234**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**.

In another configuration, generated power may travel from the power generation equipment **210** to the low side of the local step-up transformer **212**. The generated power may then travel from the high side of the local step-up transformer **212** to the high side of local step-down transformer **213**. The generated power may then travel from the low side of the local step-down transformer **213** over one or more connectors **236**A, **236**B to the one or more electrical busses **240**A, **240**B, respectively. Each of the connectors **236**A, **2346** may be a switched connector such that power may be routed independently to **240**A and/or **240**B. For illustrative purposes only, both connectors **236**A, **236**B are shown with open switches, but either or both may be closed in some embodiments. Aspects of this configuration can be used when it is preferable to connect BTM power to the outbound connector **250** or the high side of the local step-up transformer **212**, but the power must be stepped down prior to use at the BTM loads.

In one embodiment, power generated at the generation station **202** may be used to power a generation station control system **216** located at the generation station **202**, when power is available. The generation station control system **216** may typically control the operation of the generation station **202**. Generated power used at the generation station control system **216** may be supplied from bus **240**A via connector **216**A and/or from bus **240**B via connector **216**B. Each of the connectors **216**A, **216**B may be a switched connector such that power may be routed independently to **240**A and/or **240**B. While the generation station control system **216** can consume BTM power when powered via bus **240**A or bus **240**B, the BTM power taken by generation station control system **216** is insignificant in terms of rendering an economic benefit. Further, the generation station control system **216** is not configured to operate intermittently, as it generally must remain always on. Further still, the generation station control system **216** does not have the ability to quickly ramp a BTM load up or down.

In another embodiment, grid power may alternatively or additionally be used to power the generation station control system **216**. As illustrated here, metered grid power from a distribution network, such as distribution network **206** for simplicity of illustration purposes only, may be used to power generation station control system **216** over connector **216**C. Connector **216**C may be a switched connector so that metered grid power to the generation station control system **216** can be switched on or off as needed. More commonly, metered grid power would be delivered to the generation station control system **216** via a separate distribution network (not shown), and also over a switched connector. Any such grid power delivered to the generation station control system **216** is metered by a customer meter **206**A and subject to T&D costs.

In another embodiment, when power generation equipment **210** is in an idle or off state and not generating power, grid power may backfeed into generation station **202** through POI **103** and such grid power may power the generation station control system **216**.

In some configurations, an energy storage system **218** may be connected to the generation station **202** via connector **218**A, which may be a switched connector. For illustrative purposes only, connector **218**A is shown with an open switch but in some embodiments it may be closed. The energy storage system **218** may be connected to bus **240**A and/or bus **240**B and store energy produced by the power generation equipment **210**. The energy storage system may also be isolated from generation station **202** by switch **242**A. In times of need, such as when the power generation equipment in an idle or off state and not generating power, the energy storage system may feed power to, for example, the flexible datacenters **220**. The energy storage system may also be isolated from the flexible datacenters **220** by switch **242**B.

In a preferred embodiment, as illustrated, power generation equipment **210** supplies BTM power via connector **242** to flexible datacenters **220**. The BTM power used by the flexible datacenters **220** was generated by the generation station **202** and did not pass through the POI **103** or utility-scale generation-side meter **253**, and is not subject to T&D charges. Power received at the flexible datacenters **220** may be received through respective power input connectors **220**A. Each of the respective connectors **220**A may be switched connector that can electrically isolate the respective flexible datacenter **220** from the connector **242**. Power equipment **220**B may be arranged between the flexible datacenters **220** and the connector **242**. The power equipment **220**B may include, but is not limited to, power conditioners, unit transformers, inverters, and isolation equipment. As illustrated, each flexible datacenter **220** may be served by a respective power equipment **220**B. However, in another embodiment, one power equipment **220**B may serve multiple flexible datacenter **220**.

In one embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter and electrically connected to the power generation equipment **210** behind (i.e., prior to) the generation station's POI **103** with the rest of the electrical grid.

In one embodiment, BTM power produced by the power generation equipment **210** is utilized by the flexible datacenters **220** behind (i.e., prior to) the generation station's POI with an electrical grid.

In another embodiment, flexible datacenters **220** may be considered BTM equipment located behind-the-meter as the flexible datacenters **220** are electrically connected to the generation station **202**, and generation station **202** is subject to metering by utility-scale generation-side meter **253** (or **253**A, or another utility-scale generation-side meter), and the flexible datacenters **220** receive power from the generation station **202**, but the power received by the flexible datacenters **220** from the generation station **202** has not passed through a utility-scale generation-side meter. In this embodiment, the utility-scale generation-side meter **253** (or **253**A) for the generation station **202** is located at the generation station's **202** POI **103**. In another embodiment, the utility-scale generation-side meter for the generation station **202** is at a location other than the POI for the generation station **202**—for example, a substation (not shown) between the generation station **202** and the generation station's POI **103**.

In another embodiment, power from the generation station **202** is supplied to the flexible datacenters **220** as BTM power, where power produced at the generation station **202** is subject to metering by utility-scale generation-side meter

253 (or 253A, or another utility-scale generation-side meter), but the BTM power supplied to the flexible datacenters 220 is utilized before being metered at the utility-scale generation-side meter 253 (or 253A, or another utility-scale generation-side meter). In this embodiment, the utility-scale generation-side meter 253 (or 253A) for the generation station 202 is located at the generation station's 202 POI 103. In another embodiment, the utility-scale generation-side meter for the generation station 202 is at a location other than the POI for the generation station 202—for example, a substation (not shown) between the generation station 202 and the generation station's POI 103.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter as they are electrically connected to the generation station 202 that supplies power to the grid, and the flexible datacenters 220 receive power from the generation station 202 that is not subject to T&D charges, but power otherwise received from the grid that is supplied by the generation station 202 is subject to T&D charges.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 that supplies power to a grid, and the generated power is not subject to T&D charges before being used by flexible datacenters 220, but power otherwise received from the connected grid is subject to T&D charges.

In another embodiment, flexible datacenters 220 may be considered BTM equipment located behind-the-meter because they receive power generated from the generation station 202 intended for the grid, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, power from the generation station 202 is supplied to the flexible datacenters 220 as BTM power, where electrical power is generated at the generation station 202 for distribution to the grid, and the flexible datacenters 220 receive that power, and that received power is not routed through the electrical grid before being delivered to the flexible datacenters 220.

In another embodiment, metered grid power may alternatively or additionally be used to power one or more of the flexible datacenters 220, or a portion within one or more of the flexible datacenters 220. As illustrated here for simplicity, metered grid power from a distribution network, such as distribution network 206, may be used to power one or more flexible datacenters 220 over connector 256A and/or 256B. Each of connector 256A and/or 256B may be a switched connector so that metered grid power to the flexible datacenters 220 can be switched on or off as needed. More commonly, metered grid power would be delivered to the flexible datacenters 220 via a separate distribution network (not shown), and also over switched connectors. Any such grid power delivered to the flexible datacenters 220 is metered by customer meters 206A and subject to T&D costs. In one embodiment, connector 256B may supply metered grid power to a portion of one or more flexible datacenters 220. For example, connector 256B may supply metered grid power to control and/or communication systems for the flexible datacenters 220 that need constant power and cannot be subject to intermittent BTM power. Connector 242 may supply solely BTM power from the generation station 202 to high power demand computing systems within the flexible datacenters 220, in which case at least a portion of each flexible datacenters 220 so connected is operating as a BTM load. In another embodiment, connector 256A and/or 256B may supply all power used at one or more of the flexible datacenters 220, in which case each of the flexible datacenters 220 so connected would not be operating as a BTM load.

In another embodiment, when power generation equipment 210 is in an idle or off state and not generating power, grid power may backfeed into generation station 202 through POI 103 and such grid power may power the flexible datacenters 220.

The flexible datacenters 220 are shown in an example arrangement relative to the generation station 202. Particularly, generated power from the generation station 202 may be supplied to the flexible datacenters 220 through a series of connectors and/or busses (e.g., 232B, 240B, 242, 220A). As illustrated, in other embodiments, connectors between the power generation equipment 210 and other components may be switched open or closed, allowing other pathways for power transfer between the power generation equipment 210 and components, including the flexible datacenters 220. Additionally, the connector arrangement shown is illustrative only and other circuit arrangements are contemplated within the scope of supplying BTM power to a BTM load at generation station 202. For example, there may be more or fewer transformers, or one or more of transformers 212, 213, 214 may be transformer systems with multiple steppings and/or may include additional power equipment including but not limited to power conditioners, filters, switches, inverters, and/or AC/DC-DC/AC isolators. As another example, metered grid power connections to flexible datacenters 220 are shown via both 256A and 256B; however, a single connection may connect one or more flexible datacenters 220 (or power equipment 220B) to metered grid power and the one or more flexible datacenters 220 (or power equipment 220B) may include switching apparatus to direct BTM power and/or metered grid power to control systems, communication systems, and/or computing systems as desired.

In some examples, BTM power may arrive at the flexible datacenters 220 in a three-phase AC format. As such, power equipment (e.g., power equipment 220B) at one or more of the flexible datacenters 220 may enable each flexible datacenter 220 to use one or more phases of the power. For instance, the flexible datacenters 220 may utilize power equipment (e.g., power equipment 220B, or alternatively or additionally power equipment that is part of the flexible datacenter 220) to convert BTM power received from the generation station 202 for use at computing systems at each flexible datacenter 220. In other examples, the BTM power may arrive at one or more of the flexible datacenters 220 as DC power. As such, the flexible datacenters 220 may use the DC power to power computing systems. In some such examples, the DC power may be routed through a DC-to-DC converter that is part of power equipment 220B and/or flexibles datacenter 220.

In some configurations, a flexible datacenter 220 may be arranged to only have access to power received behind-the-meter from a generation station 202. In the arrangement of FIG. 2, the flexible datacenters 220 may be arranged only with a connection to the generation station 202 and depend solely on power received behind-the-meter from the generation station 202. Alternatively or additionally, the flexible datacenters 220 may receive power from energy storage system 218.

In some configurations, one or more of the flexible datacenters 220 can be arranged to have connections to multiple sources that are capable of supplying power to a flexible datacenter 220. To illustrate a first example, the flexible datacenters 220 are shown connected to connector 242, which can be connected or disconnected via switches to

the energy storage system **218** via connector **218**A, the generation station **202** via bus **240**B, and grid power via metered connector **256**A. In one embodiment, the flexible datacenters **220** may selectively use power received behind-the-meter from the generation station **202**, stored power supplied by the energy storage system **218**, and/or grid power. For instance, flexible datacenters **220** may use power stored in the energy storage system **218** when costs for using power supplied behind-the-meter from the generation station **202** are disadvantageous. By having access to the energy storage system **218** available, the flexible datacenters **220** may use the stored power and allow the generation station **202** to subsequently refill the energy storage system **218** when cost for power behind-the-meter is low. Alternatively, the flexible datacenters **220** may use power from multiple sources simultaneously to power different components (e.g., a first set and a second set of computing systems). Thus, the flexible datacenters **220** may leverage the multiple connections in a manner that can reduce the cost for power used by the computing systems at the flexible datacenters **220**. The flexible datacenters **220** control system or the remote master control system **262** may monitor power conditions and other factors to determine whether the flexible datacenters **220** should use power from either the generation station **202**, grid power, the energy storage system **218**, none of the sources, or a subset of sources during a given time range. Other arrangements are possible as well. For example, the arrangement of FIG. **2** illustrates each flexible datacenter **220** as connected via a single connector **242** to energy storage system **218**, generation station **202**, and metered grid power via **256**A. However, one or more flexible datacenters **220** may have independent switched connections to each energy source, allowing the one or more flexible datacenters **220** to operate from different energy sources than other flexible datacenters **220** at the same time.

The selection of which power source to use at a flexible datacenter (e.g., the flexible datacenters **220**) or another type of BTM load can change based on various factors, such as the cost and availability of power from both sources, the type of computing systems using the power at the flexible datacenters **220** (e.g., some systems may require a reliable source of power for a long period), the nature of the computational operations being performed at the flexible datacenters **220** (e.g., a high priority task may require immediate completion regardless of cost), and temperature and weather conditions, among other possible factors. As such, a datacenter control system at the flexible datacenters **220**, the remote master control system **262**, or another entity (e.g., an operator at the generation station **202**) may also influence and/or determine the source of power that the flexible datacenters **220** use at a given time to complete computational operations.

In some example embodiments, the flexible datacenters **220** may use power from the different sources to serve different purposes. For example, the flexible datacenters **220** may use metered power from grid power to power one or more systems at the flexible datacenters **220** that are configured to be always-on (or almost always on), such as a control and/or communication system and/or one or more computing systems (e.g., a set of computing systems performing highly important computational operations). The flexible datacenters **220** may use BTM power to power other components within the flexible datacenters **220**, such as one or more computing systems that perform less critical computational operations.

In some examples, one or more flexible datacenters **220** may be deployed at the generation station **202**. In other examples, flexible datacenters **220** may be deployed at a location geographically remote from the generation station **202**, while still maintaining a BTM power connection to the generation station **202**.

In another example arrangement, the generation station **202** may be connected to a first BTM load (e.g., a flexible datacenter **220**) and may supply power to additional BTM loads via connections between the first BTM load and the additional BTM loads (e.g., a connection between a flexible datacenter **220** and another flexible datacenter **220**).

The arrangement in FIG. **2**, and components included therein, are for non-limiting illustration purposes and other arrangements are contemplated in examples. For instance, in another example embodiment, the arrangement of FIG. **2** may include more or fewer components, such as more BTM loads, different connections between power sources and loads, and/or a different number of datacenters. In addition, some examples may involve one or more components within the arrangement of FIG. **2** being combined or further divided.

Within the arrangement of FIG. **2**, a control system, such as the remote master control system **262** or another component (e.g., a control system associated with the grid operator, the generation station control system **216**, or a datacenter control system associated with a traditional datacenter or one or more flexible datacenters) may use information to efficiently manage various operations of some of the components within the arrangement of FIG. **2**. For example, the remote master control system **262** or another component may manage distribution and execution of computational operations at one or more traditional datacenters **260** and/or flexible datacenters **220** via one or more information-processing algorithms. These algorithms may utilize past and current information in real-time to manage operations of the different components. These algorithms may also make some predictions based on past trends and information analysis. In some examples, multiple computing systems may operate as a network to process information.

Information used to make decisions may include economic and/or power-related information, such as monitored power system conditions. Monitored power system conditions may include one or more of excess power generation at a generation station **202**, excess power at a generation station **202** that a connected grid cannot receive, power generation at a generation station **202** subject to economic curtailment, power generation at a generation station **202** subject to reliability curtailment, power generation at a generation station **202** subject to power factor correction, low power generation at a generation station **202**, start up conditions at a generation station **202**, transient power generation conditions at a generation station **202**, or testing conditions where there is an economic advantage to using behind-the-meter power generation at a generation station **202**. These different monitored power system conditions can be weighted differently during processing and analysis.

In some examples, the information can include the cost for power from available sources (e.g., BTM power at the generation station **202** versus metered grid power) to enable comparisons to be made which power source costs less. In some instances, the information may include historic prices for power to enable the remote master control system **262** or another system to predict potential future prices in similar situations (e.g., the cost of power tends to trend upwards for grid power during warmer weather and peak-use hours). The information may also indicate the availability of power from the various sources (e.g., BTM power at the generation

station **262**, the energy storage system **218** at the generation station **262**, and/or metered grid power).

In addition, the information may also include other data, including information associated with operations at components within the arrangement. For instance, the information may include data associated with performance of operations at the flexible datacenters **220** and the traditional datacenters **260**, such as the number of computational tasks currently being performed, the types of tasks being performed (e.g., type of computational operation, time-sensitivity, etc.), the number, types, and capabilities of available computing systems, the amount of computational tasks awaiting performance, and the types of computing systems at one or more datacenters, among others. The information may also include data specifying the conditions at one or more datacenters (e.g., whether or not the temperatures are in a desired range, the amount of power available within an energy storage system such as **218**), the amount of computational tasks awaiting performance in the queue of one or more of the datacenters, and the identities of the entities associated with the computational operations at one or more of the datacenters. Entities associated with computational operations may be, for example, owners of the datacenters, customers who purchase computational time at the datacenters, or other entities.

The information used by the remote master control system **262** or another component may include data associated with the computational operations to be performed, such as deadlines, priorities (e.g., high vs. low priority tasks), cost to perform based on required computing systems, the optimal computing systems (e.g., CPU vs GPU vs ASIC; processing unit capabilities, speeds, or frequencies, or instructional sets executable by the processing units) for performing each requested computational task, and prices each entity (e.g., company) is willing to pay for computational operations to be performed or otherwise supported via computing systems at a traditional datacenter **260** or a flexible datacenter **220**, among others. In addition, the information may also include other data (e.g., weather conditions at locations of datacenters or power sources, any emergencies associated with a datacenter or power source, or the current value of bids associated with an auction for computational tasks).

The information may be updated in-real time and used to make the different operational decisions within the arrangement of FIG. **2**. For instance, the information may help a component (e.g., the remote master control system **262** or a control system at a flexible datacenter **220**) determine when to ramp up or ramp down power use at a flexible datacenter **220** or when to switch one or more computing systems at a flexible datacenter **220** into a low power mode or to operate at a different frequency, among other operational adjustments. The information can additionally or alternatively help a component within the arrangement of FIG. **2** to determine when to transfer computational operations between computing systems or between datacenters based on various factors. In some instances, the information may also be used to determine when to temporarily stop performing a computational operation or when to perform a computational operation at multiple sites for redundancy or other reasons. The information may further be used to determine when to accept new computational operations from entities or when to temporarily suspend accepting new tasks to be performed due to lack of computing system availability.

The remote master control system **262** represents a computing system that is capable of obtaining, managing, and using the information described above to manage and oversee one or more operations within the arrangement of FIG. **2**. As such, the remote master control system **262** may be one or more computing systems configured to process all, or a subset of, the information described above, such as power, environment, computational characterization, and economic factors to assist with the distribution and execution of computing operations among one or more datacenters. For instance, the remote master control system **262** may be configured to obtain and delegate computational operations among one or more datacenters based on a weighted analysis of a variety of factors, including one or more of the cost and availability of power, the types and availability of the computing systems at each datacenter, current and predicted weather conditions at the different locations of flexible datacenters (e.g., flexible datacenters **220**) and generation stations (e.g., generation stations **202**), levels of power storage available at one or more energy storage systems (e.g., energy storage system **218**), and deadlines and other attributes associated with particular computational operations, among other possible factors. As such, the analysis of information performed by the remote master control system **262** may vary within examples. For instance, the remote master control system **262** may use real-time information to determine whether or not to route a computational operation to a particular flexible datacenter (e.g., a flexible datacenter **220**) or to transition a computational operation between datacenters (e.g., from traditional datacenter **260** to a flexible datacenter **220**).

As shown in FIG. **2**, the generation station **202** may be able to supply power to the grid and/or BTM loads such as flexible datacenters **220**. With such a configuration, the generation station **202** may selectively provide power to the BTM loads and/or the grid based on economic and power availability considerations. For example, the generation station **202** may supply power to the grid when the price paid for the power exceeds a particular threshold (e.g., the power price offered by operators of the flexible datacenters **220**). In some instances, the operator of a flexible datacenter and the operator of a generation station capable of supplying BTM power to the flexible datacenter may utilize a predefined arrangement (e.g., a contract) that specifies a duration and/or price range when the generation station may supply power to the flexible datacenter.

The remote master control system **262** may be capable of directing one or more flexible datacenters **220** to ramp-up or ramp-down to desired power consumption levels, and/or to control cooperative action of multiple flexible datacenters by determining how to power each individual flexible datacenter **220** in accordance with operational directives.

The configuration of the remote master control system **262** can vary within examples as further discussed with respect to FIGS. **2**, **3**, and **7-9**. The remote master control system **262** may operate as a single computing system or may involve a network of computing systems. Preferably, the remote master control system **262** is implemented across one or more servers in a fault-tolerant operating environment that ensures continuous uptime and connectivity by virtue of its distributed nature. Alternatively, although the remote master control system **262** is shown as a physically separate component arrangement for FIG. **2**, the remote master control system **262** may be combined with another component in other embodiments. To illustrate an example, the remote master control system **262** may operate as part of a flexible datacenter (e.g., a computing system or a datacenter control system of the flexible datacenter **220**), includ-

ing sharing components with a flexible datacenter, sharing power with a flexible datacenter, and/or being co-located with a flexible datacenter.

In addition, the remote master control system **262** may communicate with components within the arrangement of FIG. **2** using various communication technologies, including wired and wireless communication technologies. For instance, the remote master control system **262** may use wired (not illustrated) or wireless communication to communicate with datacenter control systems or other computing systems at the flexible datacenters **220** and the traditional datacenters **260**. The remote master control system **262** may also communicate with entities inside or outside the arrangement of FIG. **2** and other components within the arrangement of FIG. **2** via wired or wireless communication. For instance, the remote master control system **262** may use wireless communication to obtain computational operations from entities seeking support for the computational operations at one or more datacenters in exchange for payment. The remote master control system **262** may communicate directly with the entities or may obtain the computational operations from the traditional datacenters **260**. For instance, an entity may submit jobs (e.g., computational operations) to one or more traditional datacenters **260**. The remote master control system **262** may determine that transferring one or more of the computational operations to a flexible datacenter **220** may better support the transferred computational operations. For example, the remote master control system **262** may determine that the transfer may enable the computational operations to be completed quicker and/or at a lower cost. In some examples, the remote master control system **262** may communicate with the entity to obtain approval prior to transferring the one or more computational operations.

The remote master control system **262** may also communicate with grid operators and/or an operator of generation station **202** to help determine power management strategies when distributing computational operations across the various datacenters. In addition, the remote master control system **262** may communicate with other sources, such as weather prediction systems, historical and current power price databases, and auction systems, etc.

In further examples, the remote master control system **262** or another computing system within the arrangement of FIG. **2** may use wired or wireless communication to submit bids within an auction that involves a bidder (e.g., the highest bid) obtaining computational operations or other tasks to be performed. Particularly, the remote master control system **262** may use the information discussed above to develop bids to obtain computing operations for performance at available computing systems at flexible datacenters (e.g., flexible datacenters **220**).

In the example arrangement shown in FIG. **2**, the flexible datacenters **220** represent example loads that can receive power behind-the-meter from the generation station **202**. In such a configuration, the flexible datacenters **220** may obtain and utilize power behind-the-meter from the generation station **202** to perform various computational operations. Performance of a computational operation may involve one or more computing systems providing resources useful in the computational operation. For instance, the flexible datacenters **220** may include one or more computing systems configured to store information, perform calculations and/or parallel processes, perform simulations, mine cryptocurrencies, and execute applications, among other potential tasks. The computing systems can be specialized or generic and can be arranged at each flexible datacenter **220** in a variety of ways (e.g., straight configuration, zig-zag configuration) as further discussed with respect to FIGS. **6**A, **6**B. Furthermore, although the example arrangement illustrated in FIG. **2** shows configurations where flexible datacenters **220** serve as BTM loads, other types of loads can be used as BTM loads within examples.

The arrangement of FIG. **2** includes the traditional datacenters **260** coupled to metered grid power. The traditional datacenters **260** using metered grid power to provide computational resources to support computational operations. One or more enterprises may assign computational operations to the traditional datacenters **260** with expectations that the datacenters reliably provide resources without interruption (i.e., non-intermittently) to support the computational operations, such as processing abilities, networking, and/or volatile storage. Similarly, one or more enterprises may also request computational operations to be performed by the flexible datacenters **220**. The flexible datacenters **220** differ from the traditional datacenters **260** in that the flexible datacenters **220** are arranged and/or configured to be connected to BTM power, are expected to operate intermittently, and are expected to ramp load (and thus computational capability) up or down regularly in response to control directives. In some examples, the flexible datacenters **220** and the traditional datacenters **260** may have similar configurations and may only differ based on the source(s) of power relied upon to power internal computing systems. Preferably, however, the flexible datacenters **220** include particular fast load ramping abilities (e.g., quickly increase or decrease power usage) and are intended and designed to effectively operate during intermittent periods of time.

FIG. **3** shows a block diagram of the remote master control system **300** according to one or more example embodiments. Remote master control system **262** may take the form of remote master control system **300**, or may include less than all components in remote master control system **300**, different components than in remote master control system **300**, and/or more components than in remote master control system **300**.

The remote master control system **300** may perform one or more operations described herein and may include a processor **302**, a data storage unit **304**, a communication interface **306**, a user interface **308**, an operations and environment analysis module **310**, and a queue system **312**. In other examples, the remote master control system **300** may include more or fewer components in other possible arrangements.

As shown in FIG. **3**, the various components of the remote master control system **300** can be connected via one or more connection mechanisms (e.g., a connection mechanism **314**). In this disclosure, the term "connection mechanism" means a mechanism that facilitates communication between two or more devices, systems, components, or other entities. For instance, a connection mechanism can be a simple mechanism, such as a cable, PCB trace, or system bus, or a relatively complex mechanism, such as a packet-based communication network (e.g., LAN, WAN, and/or the Internet). In some instances, a connection mechanism can include a non-tangible medium (e.g., where the connection is wireless).

As part of the arrangement of FIG. **2**, the remote master control system **300** (corresponding to remote master control system **262**) may perform a variety of operations, such as management and distribution of computational operations among datacenters, monitoring operational, economic, and environment conditions, and power management. For instance, the remote master control system **300** may obtain

computational operations from one or more enterprises for performance at one or more datacenters. The remote master control system **300** may subsequently use information to distribute and assign the computational operations to one or more datacenters (e.g., the flexible datacenters **220**) that have the resources (e.g., particular types of computing systems and available power) available to complete the computational operations. In some examples, the remote master control system **300** may assign all incoming computational operation requests to the queue system **312** and subsequently assign the queued requests to computing systems based on an analysis of current market and power conditions.

Although the remote master control system **300** is shown as a single entity, a network of computing systems may perform the operations of the remote master control system **300** in some examples. For example, the remote master control system **300** may exist in the form of computing systems (e.g., datacenter control systems) distributed across multiple datacenters.

The remote master control system **300** may include one or more processors **302**. As such, the processor **302** may represent one or more general-purpose processors (e.g., a microprocessor) and/or one or more special-purpose processors (e.g., a digital signal processor (DSP)). In some examples, the processor **302** may include a combination of processors within examples. The processor **302** may perform operations, including processing data received from the other components within the arrangement of FIG. **2** and data obtained from external sources, including information such as weather forecasting systems, power market price systems, and other types of sources or databases.

The data storage unit **304** may include one or more volatile, non-volatile, removable, and/or non-removable storage components, such as magnetic, optical, or flash storage, and/or can be integrated in whole or in part with the processor **302**. As such, the data storage unit **304** may take the form of a non-transitory computer-readable storage medium, having stored thereon program instructions (e.g., compiled or non-compiled program logic and/or machine code) that, when executed by the processor **302**, cause the remote master control system **300** to perform one or more acts and/or functions, such as those described in this disclosure. Such program instructions can define and/or be part of a discrete software application. In some instances, the remote master control system **300** can execute program instructions in response to receiving an input, such as from the communication interface **306**, the user interface **308**, or the operations and environment analysis module **310**. The data storage unit **304** may also store other information, such as those types described in this disclosure.

In some examples, the data storage unit **304** may serve as storage for information obtained from one or more external sources. For example, data storage unit **304** may store information obtained from one or more of the traditional datacenters **260**, a generation station **202**, a system associated with the grid, and flexible datacenters **220**. As examples only, data storage **304** may include, in whole or in part, local storage, dedicated server-managed storage, network attached storage, and/or cloud-based storage, and/or combinations thereof.

The communication interface **306** can allow the remote master control system **300** to connect to and/or communicate with another component according to one or more protocols. For instance, the communication interface **306** may be used to obtain information related to current, future, and past prices for power, power availability, current and predicted weather conditions, and information regarding the different datacenters (e.g., current workloads at datacenters, types of computing systems available within datacenters, price to obtain power at each datacenter, levels of power storage available and accessible at each datacenter, etc.). In an example, the communication interface **306** can include a wired interface, such as an Ethernet interface or a high-definition serial-digital-interface (HD-SDI). In another example, the communication interface **406** can include a wireless interface, such as a cellular, satellite, WiMAX, or WI-FI interface. A connection can be a direct connection or an indirect connection, the latter being a connection that passes through and/or traverses one or more components, such as such as a router, switcher, or other network device. Likewise, a wireless transmission can be a direct transmission or an indirect transmission. The communication interface **306** may also utilize other types of wireless communication to enable communication with datacenters positioned at various locations.

The communication interface **306** may enable the remote master control system **300** to communicate with the components of the arrangement of FIG. **2**. In addition, the communication interface **306** may also be used to communicate with the various datacenters, power sources, and different enterprises submitting computational operations for the datacenters to support.

The user interface **308** can facilitate interaction between the remote master control system **300** and an administrator or user, if applicable. As such, the user interface **308** can include input components such as a keyboard, a keypad, a mouse, a touch-sensitive panel, a microphone, and/or a camera, and/or output components such as a display device (which, for example, can be combined with a touch-sensitive panel), a sound speaker, and/or a haptic feedback system. More generally, the user interface **308** can include hardware and/or software components that facilitate interaction between remote master control system **300** and the user of the system.

In some examples, the user interface **308** may enable the manual examination and/or manipulation of components within the arrangement of FIG. **2**. For instance, an administrator or user may use the user interface **308** to check the status of, or change, one or more computational operations, the performance or power consumption at one or more datacenters, the number of tasks remaining within the queue system **312**, and other operations. As such, the user interface **308** may provide remote connectivity to one or more systems within the arrangement of FIG. **2**.

The operations and environment analysis module **310** represents a component of the remote master control system **300** associated with obtaining and analyzing information to develop instructions/directives for components within the arrangement of FIG. **2**. The information analyzed by the operations and environment analysis module **310** can vary within examples and may include the information described above with respect predicting and/or directing the use of BTM power. For instance, the operations and environment analysis module **310** may obtain and access information related to the current power state of computing systems operating as part of the flexible datacenters **220** and other datacenters that the remote master control system **300** has access to. This information may be used to determine when to adjust power usage or mode of one or more computing systems. In addition, the remote master control system **300** may provide instructions a flexible datacenter **220** to cause a subset of the computing systems to transition into a low power mode to consume less power while still performing

operations at a slower rate. The remote master control system **300** may also use power state information to cause a set of computing systems at a flexible datacenter **220** to operate at a higher power consumption mode. In addition, the remote master control system **300** may transition computing systems into sleep states or power on/off based on information analyzed by the operations and environment analysis module **310**.

In some examples, the operations and environment analysis module **310** may use location, weather, activity levels at the flexible datacenters or the generation station, and power cost information to determine control strategies for one or more components in the arrangement of FIG. **2**. For instance, the remote master control system **300** may use location information for one or more datacenters to anticipate potential weather conditions that could impact access to power. In addition, the operations and environment analysis module **310** may assist the remote master control system **300** determine whether to transfer computational operations between datacenters based on various economic and power factors.

The queue system **312** represents a queue capable of organizing computational operations to be performed by one or more datacenters. Upon receiving a request to perform a computational operation, the remote master control system **300** may assign the computational operation to the queue until one or more computing systems are available to support the computational operation. The queue system **312** may be used for organizing and transferring computational tasks in real time.

The organizational design of the queue system **312** may vary within examples. In some examples, the queue system **312** may organize indications (e.g., tags, pointers) to sets of computational operations requested by various enterprises. The queue system **312** may operate as a First-In-First-Out (FIFO) data structure. In a FIFO data structure, the first element added to the queue will be the first one to be removed. As such, the queue system **312** may include one or more queues that operate using the FIFO data structure.

In some examples, one or more queues within the queue system **312** may use other designs of queues, including rules to rank or organize queues in a particular manner that can prioritize some sets of computational operations over others. The rules may include one or more of an estimated cost and/or revenue to perform each set of computational operations, an importance assigned to each set of computational operations, and deadlines for initiating or completing each set of computational operations, among others. Examples using a queue system are further described below with respect to FIG. **9**.

In some examples, the remote master control system **300** may be configured to monitor one or more auctions to obtain computational operations for datacenters to support. Particularly, the remote master control system **300** may use resource availability and power prices to develop and submit bids to an external or internal auction system for the right to support particular computational operations. As a result, the remote master control system **300** may identify computational operations that could be supported at one or more flexible datacenters **220** at low costs.

FIG. **4** is a block diagram of a generation station **400**, according to one or more example embodiments. Generation station **202** may take the form of generation station **400**, or may include less than all components in generation station **400**, different components than in generation station **400**, and/or more components than in generation station **400**. The generation station **400** includes power generation equipment **401**, a communication interface **408**, a behind-the-meter interface **406**, a grid interface **404**, a user interface **410**, a generation station control system **414**, and power transformation equipment **402**. The power generation equipment **210** may take the form of power generation equipment **401**, or may include less than all components in power generation equipment **401**, different components than in power generation equipment **401**, and/or more components than in power generation equipment **401**. Generation station control system **216** may take the form of generation station control system **414**, or may include less than all components in generation station control system **414**, different components than in generation station control system **414**, and/or more components than in generation station control system **414**. Some or all of the components generation station **400** may be connected via a communication interface **516**. These components are illustrated in FIG. **4** to convey an example configuration for the generation station **400** (corresponding to generation station **202** shown in FIG. **2**). In other examples, the generation station **400** may include more or fewer components in other arrangements.

The generation station **400** can correspond to any type of grid-connected utility-scale power producer capable of supplying power to one or more loads. The size, amount of power generated, and other characteristics of the generation station **400** may differ within examples. For instance, the generation station **400** may be a power producer that provides power intermittently. The power generation may depend on monitored power conditions, such as weather at the location of the generation station **400** and other possible conditions. As such, the generation station **400** may be a temporary arrangement, or a permanent facility, configured to supply power. The generation station **400** may supply BTM power to one or more loads and supply metered power to the electrical grid. Particularly, the generation station **400** may supply power to the grid as shown in the arrangement of FIG. **2**.

The power generation equipment **401** represents the component or components configured to generate utility-scale power. As such, the power generation equipment **401** may depend on the type of facility that the generation station **400** corresponds to. For instance, the power generation equipment **401** may correspond to electric generators that transform kinetic energy into electricity. The power generation equipment **401** may use electromagnetic induction to generate power. In other examples, the power generation equipment **401** may utilize electrochemistry to transform chemical energy into power. The power generation equipment **401** may use the photovoltaic effect to transform light into electrical energy. In some examples, the power generation equipment **401** may use turbines to generate power. The turbines may be driven by, for example, wind, water, steam or burning gas. Other examples of power production are possible.

The communication interface **408** can enable the generation station **400** to communicate with other components within the arrangement of FIG. **2**. As such, the communication interface **408** may operate similarly to the communication interface **306** of the remote master control system **300** and the communication interface **503** of the flexible datacenter **500**.

The generation station control system **414** may be one or more computing systems configured to control various aspects of the generation station **400**.

The BTM interface **406** is a module configured to enable the power generation equipment **401** to supply BTM power to one or more loads and may include multiple components.

The arrangement of the BTM interface **406** may differ within examples based on various factors, such as the number of flexible datacenters **220** (or **500**) coupled to the generation station **400**, the proximity of the flexible datacenters **220** (or **500**), and the type of generation station **400**, among others. In some examples, the BTM interface **406** may be configured to enable power delivery to one or more flexible datacenters positioned near the generation station **400**. Alternatively, the BTM interface **406** may also be configured to enable power delivery to one or more flexible datacenters **220** (or **500**) positioned remotely from the generation station **400**.

The grid interface **404** is a module configured to enable the power generation equipment **401** to supply power to the grid and may include multiple components. As such, the grid interface **404** may couple to one or more transmission lines (e.g., transmission lines **404***a* shown in FIG. **2**) to enable delivery of power to the grid.

The user interface **410** represents an interface that enables administrators and/or other entities to communicate with the generation station **400**. As such, the user interface **410** may have a configuration that resembles the configuration of the user interface **308** shown in FIG. **3**. An operator may utilize the user interface **410** to control or monitor operations at the generation station **400**.

The power transformation equipment **402** represents equipment that can be utilized to enable power delivery from the power generation equipment **401** to the loads and to transmission lines linked to the grid. Example power transformation equipment **402** includes, but is not limited to, transformers, inverters, phase converters, and power conditioners.

FIG. **5** shows a block diagram of a flexible datacenter **500**, according to one or more example embodiments. Flexible datacenters **220** may take the form of flexible datacenter **500**, or may include less than all components in flexible datacenter **500**, different components than in flexible datacenter **500**, and/or more components than in flexible datacenter **500**. In the example embodiment shown in FIG. **5**, the flexible datacenter **500** includes a power input system **502**, a communication interface **503**, a datacenter control system **504**, a power distribution system **506**, a climate control system **508**, one or more sets of computing systems **512**, and a queue system **514**. These components are shown connected by a communication bus **528**. In other embodiments, the configuration of flexible datacenter **500** can differ, including more or fewer components. In addition, the components within flexible datacenter **500** may be combined or further divided into additional components within other embodiments.

The example configuration shown in FIG. **5** represents one possible configuration for a flexible datacenter. As such, each flexible datacenter may have a different configuration when implemented based on a variety of factors that may influence its design, such as location and temperature that the location, particular uses for the flexible datacenter, source of power supplying computing systems within the flexible datacenter, design influence from an entity (or entities) that implements the flexible datacenter, and space available for the flexible datacenter. Thus, the embodiment of flexible datacenter **220** shown in FIG. **2** represents one possible configuration for a flexible datacenter out of many other possible configurations.

The flexible datacenter **500** may include a design that allows for temporary and/or rapid deployment, setup, and start time for supporting computational operations. For instance, the flexible datacenter **500** may be rapidly deployed at a location near a source of generation station power (e.g., near a wind farm or solar farm). Rapid deployment may involve positioning the flexible datacenter **500** at a target location and installing and/or configuring one or more racks of computing systems within. The racks may include wheels to enable swift movement of the computing systems. Although the flexible datacenter **500** could theoretically be placed anywhere, transmission losses may be minimized by locating it proximate to BTM power generation.

The physical construction and layout of the flexible datacenter **500** can vary. In some instances, the flexible datacenter **500** may utilize a metal container (e.g., a metal container **602** shown in FIG. **6**A). In general, the flexible datacenter **500** may utilize some form of secure weatherproof housing designed to protect interior components from wind, weather, and intrusion. The physical construction and layout of example flexible datacenters are further described with respect to FIGS. **6**A-**6**B.

Within the flexible datacenter **500**, various internal components enable the flexible datacenter **500** to utilize power to perform some form of operations. The power input system **502** is a module of the flexible datacenter **500** configured to receive external power and input the power to the different components via assistance from the power distribution system **506**. As discussed with respect to FIG. **2**, the sources of external power feeding a flexible datacenter can vary in both quantity and type (e.g., the generation stations **202**, **400**, grid-power, energy storage systems). Power input system **502** includes a BTM power input sub-system **522**, and may additionally include other power input sub-systems (e.g., a grid-power input sub-system **524** and/or an energy storage input sub-system **526**). In some instances, the quantity of power input sub-systems may depend on the size of the flexible datacenter and the number and/or type of computing systems being powered. In an example embodiment, the flexible datacenter may use grid power as the primary power supply.

In some embodiments, the power input system **502** may include some or all of flexible datacenter Power Equipment **220**B. The power input system **502** may be designed to obtain power in different forms (e.g., single phase or three-phase behind-the-meter alternating current ("AC") voltage, and/or direct current ("DC") voltage). As shown, the power input system **502** includes a BTM power input sub-system **522**, a grid power input sub-system **524**, and an energy input sub-system **526**. These sub-systems are included to illustrate example power input sub-systems that the flexible datacenter **500** may utilize, but other examples are possible. In addition, in some instances, these sub-systems may be used simultaneously to supply power to components of the flexible datacenter **500**. The sub-systems may also be used based on available power sources.

In some implementations, the BTM power input sub-system **522** may include one or more AC-to-AC step-down transformers used to step down supplied medium-voltage AC to low voltage AC (e.g., 120V to 600V nominal) used to power computing systems **512** and/or other components of flexible datacenter **500**. The power input system **502** may also directly receive single-phase low voltage AC from a generation station as BTM power, from grid power, or from a stored energy system such as energy storage system **218**. In some implementations, the power input system **502** may provide single-phase AC voltage to the datacenter control system **504** (and/or other components of flexible datacenter **500**) independent of power supplied to computing systems **512** to enable the datacenter control system **504** to perform

management operations for the flexible datacenter **500**. For instance, the grid power input sub-system **524** may use grid power to supply power to the datacenter control system **504** to ensure that the datacenter control system **504** can perform control operations and communicate with the remote master control system **300** (or **262**) during situations when BTM power is not available. As such, the datacenter control system **504** may utilize power received from the power input system **502** to remain powered to control the operation of flexible datacenter **500**, even if the computational operations performed by the computing system **512** are powered intermittently. In some instances, the datacenter control system **504** may switch into a lower power mode to utilize less power while still maintaining the ability to perform some functions.

The power distribution system **506** may distribute incoming power to the various components of the flexible datacenter **500**. For instance, the power distribution system **506** may direct power (e.g., single-phase or three-phase AC) to one or more components within flexible datacenter **500**. In some embodiments, the power distribution system **506** may include some or all of flexible datacenter Power Equipment **220**B.

In some examples, the power input system **502** may provide three phases of three-phase AC voltage to the power distribution system **506**. The power distribution system **506** may controllably provide a single phase of AC voltage to each computing system or groups of computing systems **512** disposed within the flexible datacenter **500**. The datacenter control system **504** may controllably select which phase of three-phase nominal AC voltage that power distribution system **506** provides to each computing system **512** or groups of computing systems **512**. This is one example manner in which the datacenter control system **504** may modulate power delivery (and load at the flexible datacenter **500**) by ramping-up flexible datacenter **500** to fully operational status, ramping-down flexible datacenter **500** to offline status (where only datacenter control system **504** remains powered), reducing load by withdrawing power delivery from, or reducing power to, one or more of the computing systems **512** or groups of the computing systems **512**, or modulating power factor correction for the generation station **300** (or **202**) by controllably adjusting which phases of three-phase nominal AC voltage are used by one or more of the computing systems **512** or groups of the computing systems **512**. The datacenter control system **504** may direct power to certain sets of computing systems based on computational operations waiting for computational resources within the queue system **514**. In some embodiments, the flexible datacenter **500** may receive BTM DC power to power the computing systems **512**.

One of ordinary skill in the art will recognize that a voltage level of three-phase AC voltage may vary based on an application or design and the type or kind of local power generation. As such, a type, kind, or configuration of the operational AC-to-AC step down transformer (not shown) may vary based on the application or design. In addition, the frequency and voltage level of three-phase AC voltage, single-phase AC voltage, and DC voltage may vary based on the application or design in accordance with one or more embodiments.

As discussed above, the datacenter control system **504** may perform operations described herein, such as dynamically modulating power delivery to one or more of the computing systems **512** disposed within flexible datacenter **500**. For instance, the datacenter control system **504** may modulate power delivery to one or more of the computing systems **512** based on various factors, such as BTM power availability or an operational directive from a generation station **262** or **300** control system, a remote master control system **262** or **300**, or a grid operator. In some examples, the datacenter control system **504** may provide computational operations to sets of computing systems **512** and modulate power delivery based on priorities assigned to the computational operations. For instance, an important computational operation (e.g., based on a deadline for execution and/or price paid by an entity) may be assigned to a particular computing system or set of computing systems **512** that has the capacity, computational abilities to support the computational operation. In addition, the datacenter control system **504** may also prioritize power delivery to the computing system or set of computing systems **512**.

In some example, the datacenter control system **504** may further provide directives to one or more computing systems to change operations in some manner. For instance, the datacenter control system **504** may cause one or more computing systems **512** to operate at a lower or higher frequency, change clock cycles, or operate in a different power consumption mode (e.g., a low power mode). These abilities may vary depending on types of computing systems **512** available at the flexible datacenter **500**. As a result, the datacenter control system **504** may be configured to analyze the computing systems **512** available either on a periodic basis (e.g., during initial set up of the flexible datacenter **500**) or in another manner (e.g., when a new computational operation is assigned to the flexible datacenter **500**).

The datacenter control system **504** may also implement directives received from the remote master control system **262** or **300**. For instance, the remote master control system **262** or **300** may direct the flexible datacenter **500** to switch into a low power mode. As a result, one or more of the computing systems **512** and other components may switch to the low power mode in response.

The datacenter control system **504** may utilize the communication interface **503** to communicate with the remote master control system **262** or **300**, other datacenter control systems of other datacenters, and other entities. As such, the communication interface **503** may include components and operate similar to the communication interface **306** of the remote master control system **300** described with respect to FIG. **4**.

The flexible datacenter **500** may also include a climate control system **508** to maintain computing systems **512** within a desired operational temperature range. The climate control system **508** may include various components, such as one or more air intake components, an evaporative cooling system, one or more fans, an immersive cooling system, an air conditioning or refrigerant cooling system, and one or more air outtake components. One of ordinary skill in the art will recognize that any suitable heat extraction system configured to maintain the operation of computing systems **512** within the desired operational temperature range may be used.

The flexible datacenter **500** may further include an energy storage system **510**. The energy storage system **510** may store energy for subsequent use by computing systems **512** and other components of flexible datacenter **500**. For instance, the energy storage system **510** may include a battery system. The battery system may be configured to convert AC voltage to DC voltage and store power in one or more storage cells. In some instances, the battery system may include a DC-to-AC inverter configured to convert DC

voltage to AC voltage, and may further include an AC phase-converter, to provide AC voltage for use by flexible datacenter **500**.

The energy storage system **510** may be configured to serve as a backup source of power for the flexible datacenter **500**. For instance, the energy storage system **510** may receive and retain power from a BTM power source at a low cost (or no cost at all). This low-cost power can then be used by the flexible datacenter **500** at a subsequent point, such as when BTM power costs more. Similarly, the energy storage system **510** may also store energy from other sources (e.g., grid power). As such, the energy storage system **510** may be configured to use one or more of the sub-systems of the power input system **502**.

In some examples, the energy storage system **510** may be external to the flexible datacenter **500**. For instance, the energy storage system **510** may be an external source that multiple flexible datacenters utilize for back-up power.

The computing systems **512** represent various types of computing systems configured to perform computational operations. Performance of computational operations include a variety of tasks that one or more computing systems may perform, such as data storage, calculations, application processing, parallel processing, data manipulation, cryptocurrency mining, and maintenance of a distributed ledger, among others. As shown in FIG. **5**, the computing systems **512** may include one or more CPUs **516**, one or more GPUs **518**, and/or one or more Application-Specific Integrated Circuits (ASIC's) **520**. Each type of computing system **512** may be configured to perform particular operations or types of operations.

Due to different performance features and abilities associated with the different types of computing systems, the datacenter control system **504** may determine, maintain, and/or relay this information about the types and/or abilities of the computing systems, quantity of each type, and availability to the remote master control system **262** or **300** on a routine basis (e.g., periodically or on-demand). This way, the remote master control system **262** or **300** may have current information about the abilities of the computing systems **512** when distributing computational operations for performance at one or more flexible datacenters. Particularly, the remote master control system **262** or **300** may assign computational operations based on various factors, such as the types of computing systems available and the type of computing systems required by each computing operation, the availability of the computing systems, whether computing systems can operate in a low power mode, and/or power consumption and/or costs associated with operating the computing systems, among others.

The quantity and arrangement of these computing systems **512** may vary within examples. In some examples, the configuration and quantity of computing systems **512** may depend on various factors, such as the computational tasks that are performed by the flexible datacenter **500**. In other examples, the computing systems **512** may include other types of computing systems as well, such as DSPs, SIMDs, neural processors, and/or quantum processors.

As indicated above, the computing systems **512** can perform various computational operations, including in different configurations. For instance, each computing system may perform a particular computational operation unrelated to the operations performed at other computing systems. Groups of the computing systems **512** may also be used to work together to perform computational operations.

In some examples, multiple computing systems may perform the same computational operation in a redundant configuration. This redundant configuration creates a back-up that prevents losing progress on the computational operation in situations of a computing failure or intermittent operation of one or more computing systems. In addition, the computing systems **512** may also perform computational operations using a check point system. The check point system may enable a first computing system to perform operations up to a certain point (e.g., a checkpoint) and switch to a second computing system to continue performing the operations from that certain point. The check point system may also enable the datacenter control system **504** to communicate statuses of computational operations to the remote master control system **262** or **300**. This can further enable the remote master control system **262 300** to transfer computational operations between different flexible datacenters allowing computing systems at the different flexible datacenters to resume support of computational operations based on the check points.

The queue system **514** may operate similar to the queue system **312** of the remote master control system **300** shown in FIG. **3**. Particularly, the queue system **514** may help store and organize computational tasks assigned for performance at the flexible datacenter **500**. In some examples, the queue system **514** may be part of a distributed queue system such that each flexible datacenter in a fleet of flexible datacenter includes a queue, and each queue system **514** may be able to communicate with other queue systems. In addition, the remote master control system **262** or **300** may be configured to assign computational tasks to the queues located at each flexible datacenter (e.g., the queue system **514** of the flexible datacenter **500**). As such, communication between the remote master control system **262** or **300** and the datacenter control system **504** and/or the queue system **514** may allow organization of computational operations for the flexible datacenter **500** to support.

FIG. **6**A shows another structural arrangement for a flexible datacenter, according to one or more example embodiments. The particular structural arrangement shown in FIG. **6**A may be implemented at flexible datacenter **500**. The illustration depicts the flexible datacenter **500** as a mobile container **702** equipped with the power input system **502**, the power distribution system **506**, the climate control system **508**, the datacenter control system **504**, and the computing systems **512** arranged on one or more racks **604**. These components of flexible datacenter **500** may be arranged and organized according to an example structural region arrangement. As such, the example illustration represents one possible configuration for the flexible datacenter **500**, but others are possible within examples.

As discussed above, the structural arrangement of the flexible datacenter **500** may depend on various factors, such as the ability to maintain temperature within the mobile container **602** within a desired temperature range. The desired temperature range may depend on the geographical location of the mobile container **602** and the type and quantity of the computing systems **512** operating within the flexible datacenter **500** as well as other possible factors. As such, the different design elements of the mobile container **602** including the inner contents and positioning of components may depend on factors that aim to maximize the use of space within mobile container **602**, lower the amount of power required to cool the computing systems **512**, and make setup of the flexible datacenter **500** efficient. For instance, a first flexible datacenter positioned in a cooler geographic region may include less cooling equipment than a second flexible datacenter positioned in a warmer geographic region.

As shown in FIG. 6A, the mobile container **602** may be a storage trailer disposed on permanent or removable wheels and configured for rapid deployment. In other embodiments, the mobile container **602** may be a storage container (not shown) configured for placement on the ground and potentially stacked in a vertical or horizontal manner (not shown). In still other embodiments, the mobile container **602** may be an inflatable container, a floating container, or any other type or kind of container suitable for housing a mobile flexible datacenter. As such, the flexible datacenter **500** may be rapidly deployed on site near a source of unutilized behind-the-meter power generation. And in still other embodiments, the flexible datacenter **500** might not include a mobile container. For example, the flexible datacenter **500** may be situated within a building or another type of stationary environment.

FIG. **6**B shows the computing systems **512** in a straight-line configuration for installation within the flexible datacenter **500**, according to one or more example embodiments. As indicated above, the flexible datacenter **500** may include a plurality of racks **604**, each of which may include one or more computing systems **512** disposed therein. As discussed above, the power input system **502** may provide three phases of AC voltage to the power distribution system **506**. In some examples, the power distribution system **506** may controllably provide a single phase of AC voltage to each computing system **512** or group of computing systems **512** disposed within the flexible datacenter **500**. As shown in FIG. **6**B, for purposes of illustration only, eighteen total racks **604** are divided into a first group of six racks **606**, a second group of six racks **608**, and a third group of six racks **610**, where each rack contains eighteen computing systems **512**. The power distribution system (**506** of FIG. **5**) may, for example, provide a first phase of three-phase AC voltage to the first group of six racks **606**, a second phase of three-phase AC voltage to the second group of six racks **608**, and a third phase of three-phase AC voltage to the third group of six racks **610**. In other embodiments, the quantity of racks and computing systems can vary.

FIG. **7** shows a control distribution system **700** of the flexible datacenter **500** according to one or more example embodiments. The system **700** includes a grid operator **702**, a generation station control system **216**, a remote master control system **300**, and a flexible datacenter **500**. As such, the system **700** represents one example configuration for controlling operations of the flexible datacenter **500**, but other configurations may include more or fewer components in other arrangements.

The datacenter control system **504** may independently or cooperatively with one or more of the generation station control system **414**, the remote master control system **300**, and/or the grid operator **702** modulate power at the flexible datacenter **500**. During operations, the power delivery to the flexible datacenter **500** may be dynamically adjusted based on conditions or operational directives. The conditions may correspond to economic conditions (e.g., cost for power, aspects of computational operations to be performed), power-related conditions (e.g., availability of the power, the sources offering power), demand response, and/or weather-related conditions, among others.

The generation station control system **414** may be one or more computing systems configured to control various aspects of a generation station (not independently illustrated, e.g., **216** or **400**). As such, the generation station control system **414** may communicate with the remote master control system **300** over a networked connection **706** and with the datacenter control system **704** over a networked or other data connection **708**.

As discussed with respect to FIGS. **2** and **3**, the remote master control system **300** can be one or more computing systems located offsite, but connected via a network connection **710** to the datacenter control system **504**. The remote master control system **300** may provide supervisory controls or override control of the flexible datacenter **500** or a fleet of flexible datacenters (not shown).

The grid operator **702** may be one or more computing systems that are configured to control various aspects of the power grid (not independently illustrated) that receives power from the generation station. The grid operator **702** may communicate with the generation station control system **300** over a networked or other data connection **712**.

The datacenter control system **504** may monitor BTM power conditions at the generation station and determine when a datacenter ramp-up condition is met. The BTM power availability may include one or more of excess local power generation, excess local power generation that the grid cannot accept, local power generation that is subject to economic curtailment, local power generation that is subject to reliability curtailment, local power generation that is subject to power factor correction, conditions where the cost for power is economically viable (e.g., low cost to obtain power), low priced power, situations where local power generation is prohibitively low, start up situations, transient situations, or testing situations where there is an economic advantage to using locally generated behind-the-meter power generation, specifically power available at little to no cost and with no associated transmission or distribution losses or costs. For example, a datacenter control system may analyze future workload and near term weather conditions at the flexible datacenter.

In some instances, the datacenter ramp-up condition may be met if there is sufficient behind-the-meter power availability and there is no operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702** to go offline or reduce power. As such, the datacenter control system **504** may enable 714 the power input system **502** to provide power to the power distribution system **506** to power the computing systems **512** or a subset thereof.

The datacenter control system **504** may optionally direct one or more computing systems **512** to perform predetermined computational operations (e.g., distributed computing processes). For example, if the one or more computing systems **512** are configured to perform blockchain hashing operations, the datacenter control system **504** may direct them to perform blockchain hashing operations for a specific blockchain application, such as, for example, Bitcoin, Litecoin, or Ethereum. Alternatively, one or more computing systems **512** may be configured to perform high-throughput computing operations and/or high performance computing operations.

The remote master control system **300** may specify to the datacenter control system **504** what sufficient behind-the-meter power availability constitutes, or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently. For example, in certain circumstances, sufficient behind-the-meter power availability may be less than that required to fully power the entire flexible datacenter **500**. In such circumstances, the datacenter control system **504** may provide power to only a subset of computing systems, or operate the plurality of computing systems in a

lower power mode, that is within the sufficient, but less than full, range of power that is available. In addition, the computing systems **512** may adjust operational frequency, such as performing more or less processes during a given duration. The computing systems **512** may also adjust internal clocks via over-clocking or under-clocking when performing operations.

While the flexible datacenter **500** is online and operational, a datacenter ramp-down condition may be met when there is insufficient or anticipated to be insufficient, behind-the-meter power availability or there is an operational directive from the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. The datacenter control system **504** may monitor and determine when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability. As noted above, sufficiency may be specified by the remote master control system **300** or the datacenter control system **504** may be programmed with a predetermined preference or criteria on which to make the determination independently.

An operational directive may be based on current dispatch-ability, forward looking forecasts for when behind-the-meter power is, or is expected to be, available, economic considerations, reliability considerations, operational considerations, or the discretion of the generation station control system **414**, the remote master control system **300**, or the grid operator **702**. For example, the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may issue an operational directive to flexible datacenter **500** to go offline and power down. When the datacenter ramp-down condition is met, the datacenter control system **504** may disable power delivery to the plurality of computing systems (e.g., **512**). The datacenter control system **504** may disable **714** the power input system **502** from providing power (e.g., three-phase nominal AC voltage) to the power distribution system **506** to power down the computing systems **512** while the datacenter control system **504** remains powered and is capable of returning service to operating mode at the flexible datacenter **500** when behind-the-meter power becomes available again.

While the flexible datacenter **500** is online and operational, changed conditions or an operational directive may cause the datacenter control system **504** to modulate power consumption by the flexible datacenter **500**. The datacenter control system **504** may determine, or the generation station control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in less power generation, availability, or economic feasibility, than would be necessary to fully power the flexible datacenter **500**. In such situations, the datacenter control system **504** may take steps to reduce or stop power consumption by the flexible datacenter **500** (other than that required to maintain operation of datacenter control system **504**).

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to reduce power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically reduce or withdraw power delivery to one or more computing systems **512** to meet the dictate. The datacenter control system **504** may controllably provide three-phase nominal AC voltage to a smaller subset of computing systems (e.g., **512**) to reduce power consumption. The datacenter control system **504** may dynamically reduce the power consumption of one or more computing systems by reducing their operating frequency or forcing them into a lower power mode through a network directive.

Similarly, the flexible datacenter **500** may ramp up power consumption based on various conditions. For instance, the datacenter control system **504** may determine, or the generation control system **414**, the remote master control system **300**, or the grid operator **702** may communicate, that a change in local conditions may result in greater power generation, availability, or economic feasibility. In such situations, the datacenter control system **504** may take steps to increase power consumption by the flexible datacenter **500**.

Alternatively, the generation station control system **414**, the remote master control system **300**, or the grid operator **702**, may issue an operational directive to increase power consumption for any reason, the cause of which may be unknown. In response, the datacenter control system **504** may dynamically increase power delivery to one or more computing systems **512** (or operations at the computing systems **512**) to meet the dictate. For instance, one or more computing systems **512** may transition into a higher power mode, which may involve increasing power consumption and/or operation frequency.

One of ordinary skill in the art will recognize that datacenter control system **504** may be configured to have a number of different configurations, such as a number or type or kind of the computing systems **512** that may be powered, and in what operating mode, that correspond to a number of different ranges of sufficient and available behind-the-meter power. As such, the datacenter control system **504** may modulate power delivery over a variety of ranges of sufficient and available unutilized behind-the-meter power availability.

FIG. **8** shows a control distribution system **800** of a fleet of flexible datacenters according to one or more example embodiments. The control distribution system **800** of the flexible datacenter **500** shown and described with respect to FIG. **7** may be extended to a fleet of flexible datacenters as illustrated in FIG. **8**. For example, a first generation station (not independently illustrated), such as a wind farm, may include a first plurality of flexible datacenters **802**, which may be collocated or distributed across the generation station. A second generation station (not independently illustrated), such as another wind farm or a solar farm, may include a second plurality of flexible datacenters **804**, which may be collocated or distributed across the generation station. One of ordinary skill in the art will recognize that the number of flexible datacenters deployed at a given station and the number of stations within the fleet may vary based on an application or design in accordance with one or more example embodiments.

The remote master control system **300** may provide directive to datacenter control systems of the fleet of flexible datacenters in a similar manner to that shown and described with respect to FIG. **7**, with the added flexibility to make high level decisions with respect to fleet that may be counterintuitive to a given station. The remote master control system **300** may make decisions regarding the issuance of operational directives to a given generation station based on, for example, the status of each generation station where flexible datacenters are deployed, the workload distributed across fleet, and the expected computational demand required for one or both of the expected workload and predicted power availability. In addition, the remote master control system **300** may shift workloads from the first plurality of flexible datacenters **802** to the second plurality of flexible datacenters **804** for any reason, including, for

example, a loss of BTM power availability at one generation station and the availability of BTM power at another generation station. As such, the remote master control system **300** may communicate with the generation station control systems **806**A, **806**B to obtain information that can be used to organize and distribute computational operations to the fleets of flexible datacenters **802**, **804**.

FIG. **9** shows a queue distribution arrangement for a traditional datacenter **902** and a flexible datacenter **500**, according to one or more example embodiments. The arrangement of FIG. **9** includes a flexible datacenter **500**, a traditional datacenter **902**, a queue system **312**, a set of communication links **916**, **918**, **920**A, **920**B, and the remote master control system **300**. The arrangement of FIG. **9** represents an example configuration scheme that can be used to distribute computing operations using a queue system **312** between the traditional datacenter **902** and one or more flexible datacenters. In other examples, the arrangement of FIG. **9** may include more or fewer components in other potential configurations. For instance, the arrangement of FIG. **9** may not include the queue system **312** or may include routes that bypass the queue system **312**.

The arrangement of FIG. **9** may enable computational operations requested to be performed by entities (e.g., companies). As such, the arrangement of FIG. **9** may use the queue system **312** to organize incoming computational operations requests to enable efficient distribution to the flexible datacenter **500** and the critical traditional datacenter **902**. Particularly, the arrangement of FIG. **9** may use the queue system **312** to organize sets of computational operations thereby increasing the speed of distribution and performance of the different computational operations among datacenters. As a result, the use of the queue system **312** may reduce time to complete operations and reduce costs.

In some examples, one or more components, such as the datacenter control system **504**, the remote master control system **300**, the queue system **312**, or the control system **936**, may be configured to identify situations that may arise where using the flexible datacenter **500** can reduce costs or increase productivity of the system, as compared to using the traditional datacenter **902** for computational operations. For example, a component within the arrangement of FIG. **9** may identify when using behind-the-meter power to power the computing systems **512** within the flexible datacenter **500** is at a lower cost compared to using the computing systems **934** within the traditional datacenter **902** that are powered by grid power. Additionally, a component in the arrangement of FIG. **9** may be configured to determine situations when offloading computational operations from the traditional datacenter **902** indirectly (i.e., via the queue system **312**) or directly (i.e., bypassing the queue system **312**) to the flexible datacenter **500** can increase the performance allotted to the computational operations requested by an entity (e.g., reduce the time required to complete time-sensitive computational operations).

In some examples, the datacenter control system **504** may monitor activity of the computing systems **512** within the flexible datacenter **500** and use the respective activity levels to determine when to obtain computational operations from the queue system **312**. For instance, the datacenter control system **504** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **512** to perform. The various factors may include power availability at the flexible datacenter **500** (e.g., either stored or from a BTM source), availability of the computing systems **512** (e.g., percentage of computing systems available), type of computational operations available, estimated cost to perform the computational operations at the flexible datacenter **500**, cost for power, cost for power relative to cost for grid power, and instructions from other components within the system, among others. The datacenter control system **504** may analyze one or more of the factors when determining whether to obtain a new set of computational operations for the computing systems **512** to perform. In such a configuration, the datacenter control system **504** manages the activity of the flexible datacenter **500**, including determining when to acquire new sets of computational operations when capacity among the computing systems **512** permit.

In other examples, a component (e.g., the remote master control system **300**) within the system may assign or distribute one or more sets of computational operations organized by the queue system **312** to the flexible datacenter **500**. For example, the remote master control system **300** may manage the queue system **312**, including the distribution of computational operations organized by the queue system **312** to the flexible datacenter **500** and the traditional datacenter **902**. The remote master control system **300** may utilize to information described with respect to the Figures above to determine when to assign computational operations to the flexible datacenter **500**.

The traditional datacenter **902** may include a power input system **930**, a power distribution system **932**, a datacenter control system **936**, and a set of computing systems **934**. The power input system **930** may be configured to receive power from a power grid and distribute the power to the computing systems **934** via the power distribution system **932**. The datacenter control system **936** may monitor activity of the computing systems **934** and obtain computational operations to perform from the queue system **312**. The datacenter control system **936** may analyze various factors prior to requesting or accessing a set of computational operations or an indication of the computational operations for the computing systems **934** to perform. A component (e.g., the remote master control system **300**) within the arrangement of FIG. **9** may assign or distribute one or more sets of computational operations organized by the queue system **312** to the traditional datacenter **902**.

The communication link **916** represents one or more links that may serve to connect the flexible datacenter **500**, the traditional datacenter **902**, and other components within the system (e.g., the remote master control system **300**, the queue system **312**—connections not shown). In particular, the communication link **916** may enable direct or indirect communication between the flexible datacenter **500** and the traditional datacenter **902**. The type of communication link **916** may depend on the locations of the flexible datacenter **500** and the traditional datacenter **902**. Within embodiments, different types of communication links can be used, including but not limited to WAN connectivity, cloud-based connectivity, and wired and wireless communication links.

The queue system **312** represents an abstract data type capable of organizing computational operation requests received from entities. As each request for computational operations are received, the queue system **312** may organize the request in some manner for subsequent distribution to a datacenter. Different types of queues can make up the queue system **312** within embodiments. The queue system **312** may be a centralized queue that organizes all requests for computational operations. As a centralized queue, all incoming requests for computational operations may be organized by the centralized queue.

In other examples, the queue system **312** may be distributed consisting of multiple queue sub-systems. In the distributed configuration, the queue system **312** may use multiple queue sub-systems to organize different sets of computational operations. Each queue sub-system may be used to organize computational operations based on various factors, such as according to deadlines for completing each set of computational operations, locations of enterprises submitting the computational operations, economic value associated with the completion of computational operations, and quantity of computing resources required for performing each set of computational operations. For instance, a first queue sub-system may organize sets of non-intensive computational operations and a second queue sub-system may organize sets of intensive computational operations. In some examples, the queue system **312** may include queue sub-systems located at each datacenter. This way, each datacenter (e.g., via a datacenter control system) may organize computational operations obtained at the datacenter until computing systems are able to start executing the computational operations. In some examples, the queue system **312** may move computational operations between different computing systems or different datacenters in real-time.

Within the arrangement of FIG. **9**, the queue system **312** is shown connected to the remote master control system **300** via the communication link **918**. In addition, the queue system **312** is also shown connected to the flexible datacenter via the communication **920**A and to the traditional datacenter **902** via the communication link **920**B. The communication links **918**, **920**A, **920**B may be similar to the communication link **916** and can be various types of communication links within examples.

The queue system **312** may include a computing system configured to organize and maintain queues within the queue system **312**. In another example, one or more other components of the system may maintain and support queues within the queue system **312**. For instance, the remote master control system **300** may maintain and support the queue system **312**. In other examples, multiple components may maintain and support the queue system **312** in a distributed manner, such as a blockchain configuration.

In some embodiments, the remote master control system **300** may serve as an intermediary that facilitates all communication between flexible datacenter **500** and the traditional datacenter **902**. Particularly, the traditional datacenter **902** or the flexible datacenter **500** might need to transmit communications to the remote master control system **300** in order to communicate with the other datacenter. As also shown, the remote master control system **300** may connect to the queue system **312** via the communication link **918**. Computational operations may be distributed between the queue system **312** and the remote master control system **300** via the communication link **918**. The computational operations may be transferred in real-time and mid-performance from one datacenter to another (e.g., from the traditional datacenter **902** to the flexible datacenter **500**). In addition, the remote master control system **300** may manage the queue system **312**, including providing resources to support queues within the queue system **312**.

As a result, the remote master control system **300** may offload some or all of the computational operations assigned to the traditional datacenter **902** to the flexible datacenter **500**. This way, the flexible datacenter **500** can reduce overall computational costs by using the behind-the-meter power to provide computational resources to assist traditional datacenter **902**. The remote master control system **300** may use the queue system **312** to temporarily store and organize the offloaded computational operations until a flexible datacenter (e.g., the flexible datacenter **500**) is available to perform them. The flexible datacenter **500** consumes behind-the-meter power without transmission or distribution costs, which lowers the costs associated with performing computational operations originally assigned to the traditional datacenter **902**. The remote master control system **300** may further communicate with the flexible datacenter **500** via communication link **922** and the traditional datacenter **902** via the communication link **924**.

FIG. **10**A shows method **1000** of dynamic power consumption at a flexible datacenter using behind-the-meter power according to one or more example embodiments. Other example methods may be used to manipulate the power delivery to one or more flexible datacenters.

In step **1010**, the datacenter control system, the remote master control system, or another computing system may monitor behind-the-meter power availability. In some embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1020**, the datacenter control system or the remote master control system **300** may determine when a datacenter ramp-up condition is met. In some embodiments, the datacenter ramp-up condition may be met when there is sufficient behind-the-meter power availability and there is no operational directive from the generation station to go offline or reduce power.

In step **1030**, the datacenter control system may enable behind-the-meter power delivery to one or more computing systems. In some instances, the remote mater control system may directly enable BTM power delivery to computing systems within the flexible system without instructing the datacenter control system.

In step **1040**, once ramped-up, the datacenter control system or the remote master control system may direct one or more computing systems to perform predetermined computational operations. In some embodiments, the predetermined computational operations may include the execution of one or more distributed computing processes, parallel processes, and/or hashing functions, among other types of processes.

While operational, the datacenter control system, the remote master control system, or another computing system may receive an operational directive to modulate power consumption. In some embodiments, the operational directive may be a directive to reduce power consumption. In such embodiments, the datacenter control system or the remote master control system may dynamically reduce power delivery to one or more computing systems or dynamically reduce power consumption of one or more computing systems. In other embodiments, the operational directive may be a directive to provide a power factor correction factor. In such embodiments, the datacenter control system or the remote master control system may dynamically adjust power delivery to one or more computing systems to achieve a desired power factor correction factor. In still other embodiments, the operational directive may be a directive to go offline or power down. In such embodiments, the datacenter control system may disable power delivery to one or more computing systems.

FIG. **10**B shows method **1050** of dynamic power delivery to a flexible datacenter using behind-the-meter power according to one or more embodiments. In step **1060**, the datacenter control system or the remote master control system may monitor behind-the-meter power availability. In

certain embodiments, monitoring may include receiving information or an operational directive from the generation station control system or the grid operator corresponding to behind-the-meter power availability.

In step **1070**, the datacenter control system or the remote master control system may determine when a datacenter ramp-down condition is met. In certain embodiments, the datacenter ramp-down condition may be met when there is insufficient behind-the-meter power availability or anticipated to be insufficient behind-the-meter power availability or there is an operational directive from the generation station to go offline or reduce power.

In step **1080**, the datacenter control system may disable behind-the-meter power delivery to one or more computing systems. In step **1090**, once ramped-down, the datacenter control system remains powered and in communication with the remote master control system so that it may dynamically power the flexible datacenter when conditions change.

One of ordinary skill in the art will recognize that a datacenter control system may dynamically modulate power delivery to one or more computing systems of a flexible datacenter based on behind-the-meter power availability or an operational directive. The flexible datacenter may transition between a fully powered down state (while the datacenter control system remains powered), a fully powered up state, and various intermediate states in between. In addition, flexible datacenter may have a blackout state, where all power consumption, including that of the datacenter control system is halted. However, once the flexible datacenter enters the blackout state, it will have to be manually rebooted to restore power to datacenter control system. Generation station conditions or operational directives may cause flexible datacenter to ramp-up, reduce power consumption, change power factor, or ramp-down.

FIG. **11** illustrates a block diagram of a system for implementing control strategies based on a power option agreement, according to one or more embodiments. The system **1100** represents an example arrangement that includes a control system (e.g., the remote master control system **262**), a load (e.g., one or more of the datacenters **1102**, **1104**, and **1106**), and a power entity **1140**, which may establish and operate in accordance with a power option agreement. Additional arrangements are possible within examples.

In general, a power option agreement is an agreement between a power entity **1140** associated with the delivery of power to a load (e.g., a grid operator, power generation station, or local control station) and the load (e.g., the datacenters **1102-1106**). As part of the power option agreement, the load (e.g., load operator, contracting agent for the load, semi-automated control system associated with the load, and/or automated control system associated with the load) provides the power entity **1140** with the right, but not obligation, to reduce the amount of power delivered (e.g., grid power) to the load up to an agreed amount of power during an agreed upon time interval. In order to provide the power entity **1140** with this option, the load needs to be using at least the amount of power subject to the option (e.g., a minimum power threshold). For instance, the load may agree to use at least 1 MW of grid power at all times during a specified 24-hour time interval to provide the power entity **1140** with the option of being able to reduce the amount of power delivered to the load by any amount up to 1 MW at any point during the specified 24-hour time interval. The load may grant the power entity **1140** with this option in exchange for a monetary consideration (e.g., receive power at a reduced price and/or monetary payment if the option is exercised by the power entity).

The power option agreement may be used by the power entity **1140** to reserve the right to reduce the amount of grid power delivered to the load during a set time frame (e.g., the next 24 hours). For instance, the power entity **1140** may exercise a predefined power option to reduce the amount of grid power delivered to the load during a time when the grid power may be better redirected to other loads coupled to the power grid. As such, the power entity **1140** may exercise power option agreements to balance loads coupled to the power grid. In some embodiments, a power option agreement may also specify other parameters, such as costs associated with different levels of power consumption and/or maximum power thresholds for the load to operate according to.

To illustrate an example, a power option agreement may specify that a load (e.g., the datacenters **1102-1106**) is required to use at least 10 MW or more at all times during the next 12 hours. Thus, the minimum power threshold according to the power option agreement is 10 MW and this minimum power threshold extends across the time interval of the next 12 hours. In order to comply with the agreement, the load must subsequently operate using 10 MW or more power at all times during the next 12 hours. This way, the load can accommodate a situation where the power entity **1140** exercises the option. Particularly, exercising of the option may trigger the load to reduce the amount of power it consumes by an amount up to 10 MW at any point during the 12 hour interval. By establishing this power option agreement, the power entity **1140** can manipulate the amount of power consumed at the load during the next 12 hours by up to 10 MW if power needs to be redirected to another load or a reduction in power consumption is needed for other reasons.

In the example arrangement of the system **1100** shown in FIG. **11**, one or more of the datacenters (e.g., the flexible datacenters **1102**, **1104**, and the traditional datacenter **1106**) may operate as the load that is subject to a power option agreement. As the load that is subject to the power option agreement, the datacenters **1102-1106** may execute control instructions in accordance with power target consumption targets that meet or exceed the minimum power thresholds based on the power option agreement.

As shown in FIG. **11**, each datacenter **1102-1106** may include a set of computing systems configured to perform computational operations using power from one or more power sources (e.g., BTM power, grid power, and/or grid power subject to a power option agreement). In particular, the flexible datacenter **1102** includes computing systems **1108** arranged into a first set **1114**A, a second set **1114**B, and a third set **1114**C, the flexible datacenter **1104** includes computing systems **1110** arranged into a first set **1116**A, a second set **1116**B, and a third set **1118**B, and the traditional datacenter **1106** includes computing systems **1112** arranged into a first set **1118**A, a second set **1118**B, and a third set **1118**C. Each set of computing systems may include various types of computing systems that can operate in one or more modes.

The different sets of computing systems as well as the multiple datacenters are included in FIG. **11** for illustration purposes. In particular, the variety of computing systems represent different configurations that a load may take while operating in accordance with a power option agreement, and each configuration (as detailed herein) may include ramping up or down power consumption and transferring and performing computational operations between sets of comput-

ing systems and/or datacenters. In other examples, the load that is subject to a power option agreement may take on other configurations (e.g., a single datacenter **1102-1106**, and/or a single set of computing systems).

The remote master control system **262** may serve as a control system that can determine performance strategies and provide control instructions to the load (e.g., one or more of the datacenters **1102-1106**). In particular, the remote master control system **262** can monitor conditions in concert with the minimum power thresholds and time intervals (e.g., power option data) set forth in, and/or derived from, one or more power option agreements to determine performance strategies that can enable the load to meet the expectations of the power option agreement(s) while also efficiently using power to accomplish computational operations. In some instances, the remote master control system **262** may also be subject to the power option agreement and may adjust its own power consumption based on the power option agreement (e.g., ramp up or down power consumption based on the defined minimum power thresholds during time intervals).

To establish a power option agreement, the remote master control system **262** (or another computing system) may communicate with the power entity **1140**. For instance, the remote master control system **262** may provide a request (e.g., a signal and/or a bid) to the power entity **1140** and receive the terms of one or more power option agreements, or power option data related to power option agreements (e.g., data such as minimum power thresholds and time intervals, but not all terms contained within a potential power option agreement) in response. In some examples, the remote master control system **262** may evaluate one or more conditions prior to establishing a power option agreement to ensure that the conditions could enable the load (e.g., the datacenters **1102-1106**) to operate in accordance with the power option agreement. For instance, the remote master control system **262** may check the quantity and deadlines associated with computational operations assigned to specific datacenters prior to establishing specific datacenters as a load subject to a power option agreement. In some cases, multiple power option agreements may be established. For example, each datacenter **1102-1106** may be subject to a different power option agreement, which may result in the remote master control system **262** managing the power consumption at each of the datacenters **1102-1106** differently.

Within the system **1100** shown in FIG. **11**, the power entity **1140** may represent any type of power entity associated with the delivery of power to the load that is subject to a power option agreement. For instance, the power entity **1140** may be a local station control system, a grid operator, or a power generation source. As such, the power entity **1140** may establish power option agreements with the loads via communication with the loads and/or the remote master control system **262**. For example, the power entity **1140** may obtain and accept a bid from a load trying to engage in a power option agreement with the power entity **1140**. The power entity **1140** is shown with a power option module **1142**, which may be used to establish power option agreements (e.g., fixed-duration 1144 and/or dynamic **1146**).

Once a power option agreement is established, the remote master control system **262** may obtain power option data from the power entity **1140** (or another source) that specifies the power and time expectations of the power entity **1140**. As shown in FIG. **11**, the power entity **1140** includes a power option module **1142**, which may be used to provide power option data to the remote master control system **262** and/or the datacenters **1102-1106**. In particular, the power option data may specify the minimum power threshold or thresholds associated with one or more time intervals for the load to operate at in accordance with based on the power option agreement. The power option data may also specify other constraints that the load should operate in accordance with.

In some examples, the power option data may also include an indication of a monetary penalty that would be imposed upon the load for failure to operate as agreed upon for the power option agreement. In addition, the power option data may also include an indication of a monetary benefit provided to the load operating at power consumption levels that are in accordance with a power option agreement. For instance, monetary benefits could include reduced prices for power, credits for power, and/or monetary payments. In addition, the power option data may include further constraints upon power use, such as one or more maximum power thresholds and corresponding time intervals for the maximum power thresholds.

In some embodiments, the power entity **1140** may correspond to a qualified scheduling entity (QSE). A QSE may submit bids and offers on behalf of resource entities (REs) or load serving entities (LSEs), such as retail electric providers (REPs). QSEs may submit offers to sell and/or bids to buy power (energy) in the Day-Ahead Market (e.g., the next 24 hours) and the Real-Time Market. As such, the remote master control system **262** or another computing system may communicate with one or more QSEs to engage and control one or more loads in accordance with one or more power option agreements.

In some examples, a power option agreement may take the form of a fixed duration power option agreement **1144**. The fixed duration power option agreement **1144** may specify a set of minimum power thresholds and a set of time intervals in advance for an upcoming fixed duration of time covered by the agreement. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. Examples of such association are provided in FIG. **12**. The fixed duration power option agreement may be established in advanced of the time period covered by the set of time intervals to enable the remote master control system **262** to prepare performance strategies for the load (e.g., the datacenter(s)) associated with the power option agreement. Thus, the remote master control system **262** may evaluate the fixed duration power option and other monitored conditions to determine performance strategies for a set of computing systems (e.g., one or more datacenters) during the different intervals that satisfy the minimum power thresholds.

In other examples, a power option agreement may take the form of a dynamic power option agreement **1146**. For a dynamic power option agreement **1146**, minimum power thresholds may be provided to the remote master control system **262** in real-time (or near real-time). For instance, a dynamic power option agreement may specify that the power entity **1140** may provide adjustments to minimum power thresholds and corresponding time intervals in real-time to the remote master control system **262**. For example, a dynamic power option agreement may provide power option data that specifies a minimum power threshold for immediate adjustments (e.g., for the next hour).

In an embodiment, a dynamic power option agreement **1146** may involve repeat communication between the remote master control system **262** and the power entity **1140**. Particularly, the power entity **1140** may provide signals to the remote master control system **262** that request power consumption adjustments to be initiated at one or more

datacenters by the remote master control system **262** over short time intervals, such as across minutes or seconds. For example, the power entity **1140** may communicate to the remote master control system **262** to ramp power consumption down to a particular level within the next 5 minutes. As a result, the remote master control system **262** may provide instructions to one or more datacenters to ramp down power consumption using a linear ramp over the next 5 minutes to meet the particular level specified by the power entity **1140**. The remote master control system **262** may monitor the linear ramp down of power consumption and increase or decrease the rate that the datacenter(s) ramp down power use based on projections and updates received from the power entity **1140**. As a result, although the ramp down of power consumption may initially be performed in a linear manner to meet a power target threshold, the remote master control system **262** may adjust the rate of power consumption decrease based on updates from the power entity **1140**. For example, 25 percent of the overall power consumption ramp down may occur during a first period (e.g., 4 minutes 30 seconds) of the 5 minutes and the remaining 75 percent of the overall power consumption ramp down may occur during the remaining period of the 5 minutes (e.g., the final 30 seconds). The example percentages are included for illustration purposes and can vary within examples based on various parameters, such as additional communication (e.g., adjustments) provided by the power entity **1140**.

In further examples, a power option agreement may operate similarly to both a fixed-duration 1144 and a dynamic power option agreement **1146**. Particularly, power option data specifying minimum power thresholds and corresponding time intervals may be provided in advance for the entire fixed-duration of time (e.g., the next 24 hours). Additional power option data may then be subsequently provided enabling the remote master control system **262** to make one or more adjustments to accommodate any changes specified within the additional power option data. For instance, additional power option data may indicate that a power entity exercised its option to deliver less power to the load. As a result, the remote master control system may instruct the load to adjust power consumption based on the power entity reducing the power threshold minimum via exercising the option.

As indicated above, the remote master control system **262** may monitor conditions in addition to the constraints set forth in power option data received from the power entity **1140**. Particularly, the remote master control system **262** may monitor and analyze a set of conditions (including the power option data) to determine strategies for assigning, transferring, and otherwise managing computational operations using the one or more datacenters **1102-1106**. The determined strategies may enable efficient operation by the datacenters while also ensuring that the datacenters operate at target power consumption levels that meet or exceed the minimum power thresholds set forth within one or more power option agreements.

Example monitored conditions include, but are not limited to, power availability **1120**, power prices **1122**, computing systems parameters **1124**, cryptocurrency prices **1126**, computational operation parameters **1128**, and weather conditions **1129**. Power availability **1120** may include determining power consumption ranges at a set of computing systems and/or at one or more datacenters. In addition, power availability **1120** may also involve determining the source or sources of power available at a datacenter. For instance, the remote master control system **262** may identify the types of power sources (e.g., BTM, grid power, and/or a battery system) that a datacenter has available. Power prices **1122** may involve an analysis of the different costs associated with powering a set of computing systems. For instance, the remote master control system **262** may determine cost of power from the grid without a power option agreement relative to the cost power from the grid under the power option agreement. In addition, the remote master control system **262** may also compare the cost of grid power relative to the cost of BTM power when available at a datacenter. The power prices **1122** may also involve comparing the cost of using power at different datacenters to determine which datacenter may perform computational operations at a lower cost.

Monitoring computing system parameters **1124** may involve determining parameters related to the computing systems at one or more datacenters. For instance, the remote master control system **262** may monitor various parameters of the computing systems at a datacenter, such as the abilities and availability of various computing systems, the status of the queue used to store computational operations awaiting performance by the computing systems. The remote master control system **262** may determine types and operation modes of the computing systems, including which computing systems could operate in different modes (e.g., a higher power or a lower power mode) and/or at different hash rates and/or frequencies. The remote master control system **262** may also estimate when computing systems may complete current computational operations and/or how many computational operations are assigned to computing systems.

Monitoring cryptocurrency prices **1126** may involve monitoring the current price of one or more cryptocurrencies, the hash rate and/or estimated power consumption associated with mining each cryptocurrency, and other factors associated with the cryptocurrencies. The remote master control system **262** may use data related to monitoring cryptocurrency prices **1126** to determine whether using computing systems to mine a cryptocurrency generates more revenue than the cost of power required for performance of the mining operations.

The remote master control system **262** may monitor parameters related to computational operations (e.g., computational operation parameters **1128**). For example, the remote master control system **262** may monitor parameters related to the computational operations requiring performance and currently being performed, such quantity of operations, estimated time to complete, cost to perform each computational operation, deadlines and priorities associated with each computational operation. In addition, the remote master control system **262** may analyze computational operations to determine if a particular type of computing system may perform the computational operation better than other types of computing systems.

Monitoring weather conditions **1129** may include monitoring for any potential power generation disruption due to emergencies or other events, and changes in temperatures or weather conditions at power generators or datacenters that could affect power generation. As such, the operations and environment analysis module (or another component) of the remote master control system **262** may be configured to monitor one or more conditions described above.

The performance strategy determined by the remote master control system **262** based on the monitored conditions and/or power option data can include control instructions for the load (e.g., the datacenters and/or one or more sets of computing systems). For instance, a performance strategy can specify operating parameters, such as operating frequen-

cies, power consumption targets, operating modes, power on/off and/or standby states, and other operation aspects for computing systems at a datacenter.

The performance strategy can also involve aspects related to the assignment, transfer, and performance of computational operations at the computing systems. For instance, the performance strategy may specify computational operations to be performed at the computing systems, an order for completing computational operations based on priorities associated with the computational operations, and an identification of which computing systems should perform which computational operations. In some instances, priorities may depend on revenue associated with completing each computational operation and deadlines for each computational operation.

The monitored conditions may enable efficient distribution and performance of computational operations among computing systems at one or more datacenters (e.g., datacenters **1102-1106**) in ways that can reduce costs and/or time to perform computational operations, take advantage of availability and abilities of computing systems at the datacenters **1102-1106**, and/or take advantage in changes in the cost for power at the datacenters **1102-1106**. In addition, the monitored conditions may also involve consideration of the power option data to ensure that the computing systems consume enough power to meet minimum power thresholds set forth in one or more power option agreements.

The various monitored conditions described above as well as other potential conditions may change dynamically and with great frequency. Thus, to enable efficient distribution and performance of the computational operations at the datacenters, the remote master control system **262** may be configured to monitor changes in the various conditions to assist with the efficient management and operations of the computing systems at each datacenter. For instance, the remote master control system **262** may engage in wired or wireless communication **1130** with datacenter control systems (e.g., datacenter control system **504**) at each datacenter as well as other sources (e.g., the power entity **1140**) to monitor for changes in the conditions.

The remote master control system **262** may analyze the different conditions in real-time to modulate operating attributes of computing systems at one or more of the datacenters. By using the monitored conditions, the remote master control system **262** may increase revenue, decrease costs, and/or increase performance of computational operations via various modifications, such as transferring computational operations between datacenters or sets of computing systems within a datacenter and adjusting performance at one or more sets of computing systems (e.g., switching to a low power mode).

In some examples, the traditional datacenter **1106** may be the load subject to a power option agreement. As such, the remote master control system **262** may factor the power option agreement when determining whether to perform computational operations using the computing systems **1112** at the traditional datacenter **1106** and/or transfer computational operations to the computing systems **1108**, **1110** at the flexible datacenters **1102**, **1104**. For instance, the monitored conditions may indicate that the price of grid power is substantially higher than BTM power. As a result, the remote master control system **262** may transfer a subset of computational operations from the traditional datacenter **1106** to the flexible datacenters **1102**, **1104**. The traditional datacenter **1106** may still have some computational operations to perform to ensure that the traditional datacenter **1106** is using enough power to meet the minimum power threshold or thresholds set forth in the power option agreement.

In some examples, the remote master control system **262** may monitor the grid frequency signal received from the power entity **1140**. When the frequency of the grid deviates a threshold amount (e.g., 0.036 Hz above or below 60 Hz), the remote master control system **262** may adjust performance strategies at the load. In some cases, the remote master control system **262** may adjust the power consumption at the load, the number of miners (or computing systems) operating at the load, and/or the frequency or hash rate, among other possible changes. The remote master control system may readjust performance strategies at the load in response to receiving additional power option data from the power entity **1140** (e.g., an indication that the frequency of the grid is back to 60 Hz). In addition, the remote master control system **262** may communicate changes in operations at the load to the power entity **1140**. This way, the power entity **1140** may obtain confirmation that the load is adjusting in accordance with a power option agreement.

In some embodiments, a power generation source (e.g., the generation station **400** shown in FIG. **4**) may enter into a power option agreement with a grid operator, which may provide the grid operator with the option to reduce the amount of power that the power source generator can deliver to the grid during a defined time interval. For instance, a wind generation farm may enter into the power option agreement with the grid operator. In addition, the remote master control system **262** may also enter into a power option agreement with the power generation source (e.g., the wind farm) to provide a load that can receive excess power from the power generation source when the grid operator exercises the option and lowers the amount of power that the power generation source can deliver to the grid. Thus, rather than reducing the amount of power produced, the power generation source could exercise an option in the agreement with remote master control system **262** and redirect excess power to one or more loads (e.g., a set of computing systems) that could ramp up power consumption in response. In such situations, the remote master control system **262** maybe able to use the excess power from the power generation source (e.g., BTM power) to perform operations at one or more loads at a low cost (or no cost at all). In addition, the power generation source may benefit from the power option agreement by directing excess power to the load instead of temporarily halting power production.

In some examples, a power option agreement may depend on parameters associated balancing grid capacity and demand. For instance, power option agreements may incentivize power consumption ramping during periods of peak grid power use.

FIG. **12** shows a graph representing power option data based on a power option agreement, according to one or more embodiments. The graph **1200** shows power option data arranged according to power **1204** over time **1202**. As shown in FIG. **12**, time **1202** increases along the X-axis and minimum power thresholds **1204** increase along the Y-axis of the graph **1200**. In the example embodiment shown in FIG. **12**, the time **1202** increases up to a full day (e.g., 24 hours) in 4 hour increments and the power is shown in MW increasing in intervals of 5 MW. The 24 duration and example minimum power thresholds can differ in other embodiments. Particularly, these values may depend on the terms set forth within the power option agreement.

The graph line **1206** represents sets of minimum power thresholds **1206**A, **1206**B, **1206**C that are specified by

power option data based on the power option agreement. As shown, the graph line **1206** extends the entire 24 hour duration, which indicates that the set of time intervals associated with minimum power thresholds add up to 24 hours. In other examples, the power option agreement may not include a minimum power threshold during a portion of the duration.

The graph line **1206** of the graph **1200** is further used to illustrate power consumption levels that one or more loads (e.g., a set of computing systems) operating according to the power option agreement may utilize during the 24 hour duration. Particularly, the power quantities above the graph line **1206** represents power levels that the load(s) may consume from the power grid during the 24 hour duration that would satisfy the requirements (i.e., the minimum power thresholds **1206**A-**1206**C) set forth by the power option agreement. In particular, the power quantities above the graph line **1206** include any power quantity that meets or exceeds the minimum power threshold at that time. By extension, the power quantities positioned below the graph line **1206** represents the amount of power that the load could be directed to reduce power consumption by per the power option agreement.

To further illustrate, an initial minimum power threshold **1206**A is shown associated with the time interval starting at hour 0 and extending to hour 8. In particular, the minimum power threshold **1206**A is set at 5 MW during this time interval. Thus, based on the power option data shown in FIG. **12**, the loads must be able to operate at a target power consumption level that is equal to or greater than the 5 MW minimum power threshold **1206**A at all times during the time interval extending from hour 0 to hour 8, in order to be able to satisfy the power option if it is exercised for that time interval. Similarly, the power entity could reduce the power consumed by loads by any amount up to 5 MW at any point during the time interval from hour 0 to hour 8 in accordance with the power option agreement. For instance, the power entity could exercise its option at any point during this time interval to reduce the power consumed by the loads by 3 MW as a way to load balance the power grid. In response to the power entity exercising its option, the load may then operate using 3 MW less power and/or another strategy determined by a control system factoring additional conditions (e.g., the price of grid power, the revenue that could be generated from mining a cryptocurrency, and/or parameters associated with computational operations awaiting performance)

As further shown in the graph **1200** illustrated in FIG. **12**, the next minimum power threshold **1206**B is associated with the following time interval, which starts at hour 8 and extends until hour 16. During this time interval (hour 8 to hour 16), the load(s) may consume 10 MW or more power since the minimum power threshold **1206**B is now set at 10 MW as shown on the Y-axis of the graph **1200**. In light of the power option data, a control system may determine and provide a performance strategy to the load (e.g., a set of computing systems) that includes a power consumption target that meets or exceeds the minimum power threshold **1206**B (i.e., 10 MW). The performance strategy may depend on the power option data as well as other possible conditions, such as the price of grid power, the availability of computing systems, and/or the type of computing operations, etc. In addition, the power entity could exercise its option to reduce the amount of power consumed by the load by 10 MW or less as represented by the power levels under the minimum threshold **1206**B that extend during the time interval of hour 8 to hour 16.

The last minimum power threshold **1206**C is associated with the time interval that starts at hour 16 and extends until hour 24. Similar to the initial minimum power threshold **1206**A associated with the beginning of the graph line **1206**, the last minimum power threshold **1206** is also set at 5 MW. As such, at any point during this interval (hour 16 to hour 24) the loads may consume 5 MW or more to operate in accordance with the power option agreement. As discussed above, by operating at 5 MW or more, the load enables the power consumed from the power grid to be reduced any amount from zero up to 5 MW during this time interval.

When determining the power consumption strategy for a load, a computing system (e.g., the remote master control system **262**) may consider various conditions in addition to the power option data received based on one or more power option agreements. Particularly, the computing system may consider and weigh different conditions in addition to the power option data to determine power consumption targets and/or other control instructions for a load. The conditions may include, but are not limited to, the price of grid power, the price of alternative power sources (e.g., BTM power, stored energy), the revenue associated with mining for one or more cryptocurrencies, parameters related to the computational operations requiring performance (e.g., priorities, deadlines, status of the queue organizing the operations, and/or revenue associated with completing each computational operation), parameters related to the set of computing systems (e.g., types and availabilities of computing systems), and other conditions (e.g., penalties if a minimum power threshold is not met and/or monetary benefits from operating under a power option agreement). By weighing various conditions, the computing system may efficiently manage the set of computing systems, including enabling performance of computational operations cost effectively and/or ensuring at that computing systems operate at target power consumption levels that one or more satisfy power option agreements.

In some examples, the computing system may decrease the amount of power that a set of computing systems consumes from one source and while also increasing the amount of power that the set consumes from another source. For instance, the computing system may determine that the price of power grid power is above a threshold price that makes computational operations relatively expensive to perform using grid power. As a result, the computing system may provide control instructions for the computing systems to consume power grid power that matches a minimum power threshold specified by power option data. This may enable the computing systems to satisfy the power option agreement while also avoiding using pricey grid power beyond the minimum amount required per the power option data. In addition, the computing system may instruct some computing systems to switch to a low power mode or temporarily stop until the price of power from the grid decreases. The computing system may instruct one or more computing systems to operate using power from another source (e.g., BTM power and/or stored energy from a battery system) and/or transfer one or more computational operations to another set of computing systems (e.g., a different datacenter).

When the power option agreement is a fixed duration power option agreement, the computing system may receive an indication of all the minimum power thresholds **1206**A-**1206**C and an indication of the associated time interval altogether and in advance of the duration associated with the power option agreement. By providing all of the minimum power thresholds **1206**A-**1206**C and the time intervals in

advance, the computing system may determine a performance strategy for the load that can extend across the entire duration. Particularly, the computing system may factor the minimum power thresholds and associated time intervals as well as other monitored conditions to determine the performance strategy for the total duration. This can enable the computing system to accept and assign computational operations to computing systems in advance while also using a performance strategy that meets the expectations of a power option agreement.

In some examples, the performance strategy determined by the computing system may include control instructions for the set of computing systems to execute if a power option is exercised. For instance, the performance strategy may specify different power consumption targets for the computing systems that depend on whether a power option is exercised during each time interval.

In some instances, the computing system may modify the performance strategy when one or more conditions change enough to warrant a modification. For instance, the computing system may receive an indication of a change in a minimum power threshold (e.g., a decrease in the minimum power threshold) and determine one or more modifications based on the new minimum power threshold and/or other conditions (e.g., a change in the price of power).

In other examples, the power option agreement may be a dynamic power option agreement. Particularly, the load may be subject to a changing minimum power threshold that can vary during a predefined duration associated with the power option agreement. For example, a dynamic power option agreement may specify that the load is subject to a minimum power threshold that may vary from 0 MW up to 5 MW during the next 24 hours and the particular minimum threshold for each hour may depend on power option data received from the power entity during the prior hour. The dynamic power option agreement may further specify the expected response time from the load. For instance, the power option agreement may indicate that an indication of a new minimum power threshold will be provided an hour prior to the start of the minimum power threshold. The computing system, for example, may receive an indication at hour 7 about the increase in the minimum power threshold **1206**B starting at hour 8. The indication may (or may not) specify the total time interval associated with a new minimum power threshold. For instance, the indication received by the computing system may specify that the 10 MW minimum power threshold **1206**B extends from hour 8 until hour 16. In other instances, the power option data may indicate that the computing system should abide by the new minimum power threshold until receiving further power option data indicating a change to another new minimum power threshold.

In some examples, the power option data may arrive at the computing system in an unknown order from the power entity with expectations of swift power consumption adjustments by the load. As a result, the power option agreement may require fast ramping of the load to meet changes. Ramping may involve ramping up or down power consumption as well as ramping operating techniques (e.g., adjusting frequency or operation mode).

In some embodiments, the type of power option power agreement may depend on the delivery and content of power option data provided to the load (or a control system controlling the load). For instance, a computing system may receive minimum power thresholds set across an entire duration associated with a power option agreement in advance when the power option agreement is a fixed-duration power option agreement. In other instances, the computing system may receive power option data dynamically and adjust operations in real-time (or near real-time). For instance, the computing system may receive a series of power option data that each specifies minimum power threshold changes during the duration set forth in the dynamic power option agreement. To illustrate an example, the computing system may receive power option data during hour 1 that specifies the minimum power threshold for hour 2, power option data during hour 2 that specifies the minimum power threshold for hour 3, and so on across the duration of the dynamic power option agreement.

In some examples, the minimum power threshold for a time interval may be zero during the duration of a power option agreement. As such, the load may use any amount of power from the power grid in accordance with the power option agreement, including no power at all during this time interval. When the price for power is high during this time frame, the load may ramp down power usage to zero MW to avoid paying the high price for power while still being in compliance with the power option agreement.

FIG. **13** illustrates a method for implementing control strategies based on a fixed-duration power option agreement, according to one or more embodiments. The method **1300** serves as an example and may include other steps within other embodiments. A control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1300**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At step **1302**, the method **1300** involves monitoring a set of conditions. For instance, a computing system (e.g., a control system) may monitor various conditions that could impact the performance of operations at one or more loads, including the power consumption targets at the loads. The set of monitored conditions may include a variety of information obtained from one or more external sources, such as one or more datacenters, databases, power generation stations, or types of sources.

Some example conditions include, but are not limited to, the price of grid power, the price and availability of alternative power options (e.g. BTM power, and/or stored energy), parameters of the load (e.g., ramping abilities, type of computing systems, operation modes, etc.), parameters of tasks to be performed using the power at the load (e.g., types, deadlines, priorities, and/or revenue associated with computational operations), availability of other computing systems and their associated costs, and/or revenue associated with mining a cryptocurrency. The computing system may monitor one or more of these conditions as well as others.

At step **1304**, the method **1300** involves receiving power option data based, at least in part, on a power option agreement. As discussed above, the computing system (e.g., a remote master control system) may engage in a power option agreement with a power entity. As a result, the computing system may control a load (e.g., a set of computing systems) in accordance with power thresholds and time intervals received from the power entity based on the power option agreement.

In some examples, the power option data may specify a set of minimum power thresholds and a set of time intervals. Each minimum power threshold in the set of minimum power thresholds may be associated with a time interval in the set of time intervals. To illustrate an example, the power option data may specify a first minimum power threshold

associated with a first time interval and a second minimum power threshold associated with a second time interval, with the second time interval subsequent to the first time interval.

The set of time intervals may add up to the duration represented by the power option agreement. For instance, the total duration of the set of time intervals may correspond to a twenty-four hour period (e.g., the next day). In other examples, the power option agreement may span across a different duration (e.g., 12 hours). In additional embodiments, the power option data may specify other information, such as monetary incentives associated with parameters of the power option agreement and/or one or more maximum power thresholds.

At step **1306**, the method **1300** involves determining a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions. The performance strategy may be determined responsive to receiving the power option data. In addition, the performance strategy may include a power consumption target for the set of computing systems for each time interval in the set of time intervals. In some examples, each power consumption target is equal to or greater than the minimum power threshold associated with each time interval.

As an example, the performance strategy may specify a first power consumption target for the set of computing systems for a first time interval such that the first power consumption target is equal to or greater than a first minimum power threshold associated with the first time interval and a second power consumption target for the set for a second time interval in a similar manner (i.e., the second power consumption target is equal to or greater than a second minimum power threshold).

In some examples, the performance strategy may include an sequence for the set of computing systems to follow when performing computational operations. The sequence, for example, may be based on priorities associated with the computational operations. In addition, the performance strategy may include one or more power consumption targets that are greater than the minimum power thresholds when the price of power from the power grid is below a threshold price during the time intervals associated with the minimum power thresholds.

The performance strategy may also involve transferring, delaying, or adjusting one or more computational operations performed at the set of computing systems. In addition, the performance strategy may involve adjusting operations at the computing systems. For instance, one or more computing systems may switch modes (e.g., operate at a higher frequency or switch to a low power mode).

In addition, the performance strategy may also specify power consumption targets for the set of computing systems to use if the power option is exercised during an interval. This way, the computing systems may continue to perform computational operations (or suspend performance) based on the power option being exercised.

At step **1308**, the method **1300** involves providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy. For example, the set of computing systems may operate according to the performance strategy to ensure that the minimum power thresholds are met during the defined time intervals based on the power option agreement.

Some examples may further involve receiving subsequent power option data based, at least in part, on the power option agreement. The subsequent power option data may specify to decrease one or more minimum power thresholds of the set of power thresholds. Responsive to receiving the subsequent power option data, the performance strategy for the set of computing systems may be modified based on a combination of at least a portion of the subsequent power option data and one or more conditions of the monitored conditions. The modified performance strategy may include one or more reduced power consumption targets for the set of computing systems. The amount of the reduction in a power consumption target may depend linearly with the amount that the corresponding minimum power threshold was reduced by. For instance, when a minimum power threshold for a time interval is reduced from 10 MW to 5 MW, the power consumption target for that time interval may be reduced from 10 MW to 5 MW. Instructions may be provided to the set of computing systems to perform computational operations based on the modified performance strategy.

FIG. **14** illustrates a method for implementing control strategies based on a dynamic power option agreement, according to one or more embodiments. The method **1400** serves as an example and may include other steps within other embodiments. Similar to the method **1400**, a control system (e.g., the remote master control system **262**) may be configured to perform one or more steps of the method **1400**. As such, the control system may take various forms of a computing system, such as a mobile computing device, a wearable computing device, a network of computing systems, etc.

At block **1402**, the method **1400** involves monitoring a set of conditions. Similar to block **1302** of the method **1300**, a computing system may monitor various conditions to determine instructions for controlling a set of computing systems.

At block **1404**, the method **1400** involves receiving first power option data based, at least in part, on a power option agreement while monitoring the set of conditions. The first power option data may specify a first minimum power threshold associated with a first time interval. For example, the first power option data may specify a minimum power threshold of 10 MW for the next hour, which may start in an hour or less.

The power option agreement may correspond to a dynamic power option agreement in some examples. When managing a load with respect to a dynamic power option agreement, a computing system may receive power option data specifying changes in minimum power thresholds that a load (e.g., the set of computing systems) may be designated to use in the near term (e.g., the next hour). For example, the computing system may receive power option data during each hour of the duration specified by a power option agreement that indicates a minimum power threshold for the next hour.

At block **1406**, the method **1400** involves providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition. The first control instructions may be provided responsive to receiving the first power option data.

The first control instructions may include a first power consumption target for the set of computing systems for the first time interval. Particularly, the first power consumption target may be equal to or greater than the first minimum power threshold associated with the first time interval. For example, the first power consumption target may be greater than the first minimum power threshold when a cost of power from the power grid is below a threshold price during the first time interval. In other instances, the first power consumption target may be equal to the first minimum power

threshold when the cost of power from the power grid is greater than the threshold price.

In some examples, control instructions may specify a sequence for the computing systems to follow when performing computational operations. The sequence may be based on priorities associated with each computational operation.

The first control instructions may be determined based on a combination of the first power option data, the price of power from the power grid, and parameters associated with computational operations to be performed at the set of computing systems.

In some examples, the first control instructions may involve ramping up or down power consumption at the set of computing systems. The power consumption may be ramped up or down based on the first minimum power threshold and one or more other conditions (e.g., the price of power).

At block **1408**, the method **1400** involves receiving second power option data based, at least in part, on the power option agreement while monitoring the set of conditions. The computing system may receive the second power option data subsequent to receiving the first power option data. The second power option data may specify a second minimum power threshold associated with a second time interval. For example, the second minimum power threshold may be 7 MW over the duration of the upcoming hour. In other examples, the second minimum power threshold may differ as shown in FIG. **12**.

In some instances, the computing system may receive the second power option data during the first time interval such that the second time interval overlaps the first time interval. For instance, the computing system may receive the second power option data to enable real-time adjustments to be made to the power consumed at the set of computing systems.

At block **1410**, the method **1400** involves providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power option data and at least one condition. The second control instructions may be provided responsive to receiving the second power option data. The second control instructions may specify a second power consumption target for the set of computing systems for the second time interval. The second power consumption target may be equal to or greater than the second minimum power threshold associated with the second time interval.

In some examples, the computing system may provide a request to a QSE to determine the power option agreement. As such, the computing system may receive power option data (e.g., the first and second power option data) in response to providing the request to the QSE.

The computing system may monitor the price of power from the power grid, and the global mining hash rate and a price for a cryptocurrency (e.g., Bitcoin), among other conditions. The computing system may determine control instructions (e.g., the first and/or second control instructions) based on a combination of power option data, the price of power from the power grid, and the global mining hash rate and the price for the cryptocurrency. For instance, the computing system may cause one or more computing systems (e.g., a subset of computing systems) to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Advantages of one or more embodiments of the present invention may include one or more of the following:

One or more embodiments of the present invention provides a green solution to two prominent problems: the exponential increase in power required for growing blockchain operations and the unutilized and typically wasted energy generated from renewable energy sources.

One or more embodiments of the present invention allows for the rapid deployment of mobile datacenters to local stations. The mobile datacenters may be deployed on site, near the source of power generation, and receive low cost or unutilized power behind-the-meter when it is available.

One or more embodiments of the present invention provide the use of a queue system to organize computational operations and enable efficient distribution of the computational operations across multiple datacenters.

One or more embodiments of the present invention enable datacenters to access and obtain computational operations organized by a queue system.

One or more embodiments of the present invention allows for the power delivery to the datacenter to be modulated based on conditions or an operational directive received from the local station or the grid operator.

One or more embodiments of the present invention may dynamically adjust power consumption by ramping-up, ramping-down, or adjusting the power consumption of one or more computing systems within the flexible datacenter.

One or more embodiments of the present invention may be powered by behind-the-meter power that is free from transmission and distribution costs. As such, the flexible datacenter may perform computational operations, such as distributed computing processes, with little to no energy cost.

One or more embodiments of the present invention provides a number of benefits to the hosting local station. The local station may use the flexible datacenter to adjust a load, provide a power factor correction, to offload power, or operate in a manner that invokes a production tax credit and/or generates incremental revenue.

One or more embodiments of the present invention allows for continued shunting of behind-the-meter power into a storage solution when a flexible datacenter cannot fully utilize excess generated behind-the-meter power.

One or more embodiments of the present invention allows for continued use of stored behind-the-meter power when a flexible datacenter can be operational but there is not an excess of generated behind-the-meter power.

One or more embodiments of the present invention allows for management and distribution of computational operations at computing systems across a fleet of datacenters such that the performance of the computational operations take advantages of increased efficiency and decreased costs.

It will also be recognized by the skilled worker that, in addition to improved efficiencies in controlling power delivery from intermittent generation sources, such as wind farms and solar panel arrays, to regulated power grids, the invention provides more economically efficient control and stability of such power grids in the implementation of the technical features as set forth herein.

While the present invention has been described with respect to the above-noted embodiments, those skilled in the art, having the benefit of this disclosure, will recognize that other embodiments may be devised that are within the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the appended claims.

What is claimed is:

1. A system comprising:

a set of computing systems, wherein the set of computing systems is configured to perform computational operations using power from a power grid;

a control system configured to:

monitor a set of conditions;

receive power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

2. The system of claim 1, wherein the control system is configured to monitor the set of conditions comprising:

a price of power from the power grid; and

a plurality of parameters associated with one or more computational operations to be performed at the set of computing systems.

3. The system of claim 2, wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at least the portion option data, the price of power from the power grid, and the plurality of parameters associated with the one or more computational operations.

4. The system of claim 3, wherein the performance strategy further comprises:

an order for the set of computing systems to follow when performing the one or more computational operations, wherein the order is based on respective priorities associated with the one or more computational operations.

5. The system of claim 4, wherein the performance strategy further comprises:

at least one power consumption target that is greater than a minimum power threshold when the price of power from the power grid is below a threshold price during the time interval associated with the minimum power threshold.

6. The system of claim 1, wherein the control system is further configured to:

receive subsequent power option data based, at least in part, on the power option agreement,

wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

7. The system of claim 6, wherein the control system is further configured to:

responsive to receiving the subsequent power option data, modify the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions,

wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems.

8. The system of claim 7, wherein the control system is further configured to:

provide instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

9. The system of claim 1, wherein the control system is a remote master control system positioned remotely from the set of computing systems.

10. The system of claim 1, wherein the control system is a mobile computing device.

11. The system of claim 1, wherein the control system is configured to receive the power option data while monitoring the set of conditions.

12. The system of claim 1, wherein the control system is further configured to:

provide a request to a qualified scheduling entity (QSE) to determine the power option agreement; and

receive power option data in response to providing the request to the QSE.

13. The system of claim 1, wherein the power option data specify: (i) a first minimum power threshold associated with a first time interval in the set of time intervals, and (ii) a second minimum power threshold associated with a second time interval in the set of time intervals,

wherein the second time interval is subsequent to the first time interval.

14. The system of claim 13, wherein the control system is configured to:

determine the performance strategy for the set of computing systems such that the performance strategy comprises:

a first power consumption target for the set of computing systems for the first time interval, wherein the first power consumption target is equal to or greater than the first minimum power threshold; and

a second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

15. The system of claim 1, wherein a total duration of the set of time intervals corresponds to a twenty-four hour period.

16. The system of claim 1, wherein the set of conditions monitored by the control system further comprise:

a price of power from the power grid; and

a global mining hash rate and a price for a cryptocurrency; and

wherein the control system is configured to:

determine the performance strategy for the set of computing systems based on a combination of at the portion of the power option data, the price of power from the power grid, the global mining hash rate and the price for the cryptocurrency,

wherein the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

17. A method comprising:

monitoring, by a computing system, a set of conditions;

receiving, at the computing system, power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

18. The method of claim 17, wherein determining the performance strategy for the set of computing systems comprises:

identifying information about the set of computing systems; and

determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems.

19. The method of claim 17, further comprising:

receiving subsequent power option data based, at least in part, on the power option agreement, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds;

responsive to receiving the subsequent power option data, modifying the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions, wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems; and

providing instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

20. A non-transitory computer readable medium having stored therein instructions executable by one or more processors to cause a computing system to perform functions comprising:

monitoring a set of conditions;

receiving power option data based, at least in part, on a power option agreement, wherein the power option data specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals;

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions, wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals, wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval; and

providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy.

* * * * *

EXHIBIT B

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Methods and Systems for Adjusting Power Consumption based on a Fixed-Duration Power Option Agreement

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☒ The attached application, or
- ☐ United States application or PCT international application number ______________________

  filed on ______________________.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Michael T. McNamara Date (Optional) : Dec 2, 2019

Signature: ______________________

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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- [ ] United States application or PCT international application number ______________________

filed on ______________________.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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LEGAL NAME OF INVENTOR

Inventor: Raymond E. Cline Jr. Date (Optional) : 12/3/2019

Signature: [signature]

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

Style Definition: Heading 1: Indent: Left: 0", Tab stops: Not at 1.38"

Style Definition: Comment Text

BEARBOX LLC and AUSTIN STORMS, Plaintiffs, v. LANCIUM LLC, MICHAEL T. MCNAMARA, and RAYMOND E. CLINE, JR. Defendants.	)))))))))))	C.A. No. 21-534-MN-CJB **JURY TRIAL DEMANDED**

SECOND AMENDED COMPLAINT

Plaintiffs BearBox LLC ("BearBox") and Austin Storms (collectively, "Plaintiffs" or "BearBox") bring this action against Lancium LLC ("Lancium"), Michael T. McNamara, and Raymond E. Cline, Jr. (collectively "Defendants") to correct the inventorship of U.S. Patent No. 10,608,433 (the "'433 Patent") and to recover damages, injunctive relief, declaratory relief, and other remedies for Defendants' wrongful actions to obtain, convert, misuse, disclose, and claim as their own Plaintiffs' proprietary cryptocurrency mining technology. Plaintiffs further allege as follows:

INTRODUCTION

1. This case is about the Defendants' theft ~~of~~and unauthorized use of system designs, data, know-how, and physical documents describing those designs, data, and know-how, as well as inventions that rightfully belong to Plaintiffs.

2. Plaintiffs developed proprietary technology relating to cryptocurrency mining systems~~ (the "BearBox Technology")~~.. By way of background, ~~the BearBox Technology~~BearBox's technology generally relates to an energy-efficient cryptocurrency mining

{01772484;v1 }

system and related methods that reduce the inefficiency and environmental impact of energy-~~expensive~~intensive mining operations by better utilizing available energy resources to increase the stability of the energy grid, minimize a mining operation's impact on peak-demand, and also alleviate energy ~~over-supply~~oversupply and undersupply conditions. ~~The BearBox Technology~~BearBox's technology can be used to mine cryptocurrency, such as Bitcoin.

3. The Defendants deceptively induced the Plaintiffs to disclose ~~the BearBox Technology~~ BearBox's technology to them under the guise of a possible business deal or "collaboration," a word used by McNamara in encouraging Plaintiffs' disclosures, between Defendants and Plaintiffs to jointly commercialize the BearBox Technology. ~~Before disclosing the BearBox Technology to Defendants, Plaintiffs obtained assurances of confidentiality from Defendants.~~

4. The Defendants stole ~~the BearBox Technology~~BearBox's technology, including system designs, documents, data, and know-how, from Plaintiffs by converting ~~and misappropriating~~ it and ~~claiming~~using it to modify Defendants' software, e.g. Smart Response™, to operate as ~~their own.~~ BearBox's technology did, and then selling, licensing, seeking investments in support of, and otherwise monetizing that modified Smart Response™ software for great profit.

~~4.~~5. Defendants ~~filed~~went even further, by filing a U.S. patent application, which later matured into the '433 Patent, that wrongfully disclosed ~~the BearBox Technology~~portions of BearBox's technology to the U.S. Patent and Trademark Office and ultimately to the public~~.~~ as technology that was invented by Defendants. The claimed subject matter of the '433 Patent falls fully within the scope of ~~the BearBox Technology. And by~~BearBox's technology, though is not a complete representation of the BearBox technology. By obtaining the '433 Patent with claims

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directed to ~~the BearBox Technology~~portions of BearBox's technology, the Defendants have wrongfully obtained a patent ~~covering the BearBox Technology and wrongfully claimed the BearBox Technology as~~ that prevents Plaintiffs from building their own system, or otherwise monetizing their ~~own~~system designs, data, documents, and know-how.

6. ~~Plaintiffs~~Plaintiffs bring this action to recover damages caused by Defendants' theft and unauthorized use, and subsequent exploitation of Plaintiffs system design, data, documents, and know-how.

~~5.~~7. Plaintiffs also bring this action to correct the named inventors on the '433 Patent. The inventions claimed in the '433 Patent are inventions conceived by Storms, founder and president of BearBox.

PARTIES

~~6.~~8. ~~Plaintiff~~ BearBox LLC ~~("BearBox")~~ is a limited liability company organized and existing under the laws of Louisiana with its principal place of business at 4422 Highway 22, Mandeville, Louisiana 70471.

~~7.~~9. Plaintiff Austin Storms is an individual residing in Mandeville, Louisiana.

~~8.~~10. On information and belief, Defendant Lancium is a Delaware limited liability company with its principal place of business at 6006 Thomas Rd, Houston, Texas 77041. On information and belief, Lancium has a registered agent capable of accepting service in this district, Harvard Business Services, Inc. with a place of business at 16192 Coastal Highway, Lewes, DE 19958.

~~9.~~11. On information and belief, Defendant Michael T. McNamara is the Chief Executive Officer and a founder of Lancium and resides in Newport Beach, California. Defendant McNamara is named as a purported inventor on the face of the '433 Patent.

~~10.~~12. On information and belief, Defendant Raymond E. Cline, Jr. is the Chief Computing Officer of Lancium and resides in Houston, Texas. Defendant Cline is named as a purported inventor on the face of the '433 Patent.

JURISDICTION

~~11.~~13. This is an action seeking correction of the named inventors of a United States patent under 35 U.S.C. § 256. As such, this action arises under the laws of the United States.

~~12.~~14. This Court has exclusive subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a) because the matter arises under an Act of Congress relating to patents, specifically 35 U.S.C. § 256.

~~13.~~15. The Court has supplemental jurisdiction under 28 U.S.C. § 1367 over all asserted claims under state law because those claims are so related to the claims in this action that arise under federal law that they form part of the same case or controversy.

~~14.~~16. The Court also has jurisdiction pursuant to 28 U.S.C. § 1332, as complete diversity of citizenship exists among the parties, and the amount in controversy exceeds $75,000. Plaintiff BearBox is a citizen of the State of Louisiana because it is organized under the laws of the State of Louisiana and has its principal place of business in the State of Louisiana. Plaintiff Storms is a citizen of the State of Louisiana because he resides in the State of Louisiana. In contrast, none of the Defendants are citizens of the State of Louisiana. Defendant Lancium is a citizen of the States of Delaware and Texas because it is organized under the laws of the State of Delaware and has its principal place of business in the State of Texas. Defendant McNamara is a citizen of the State of California because he resides in the State of California. Defendant Cline is a citizen of the State of Texas because he resides in the State of Texas. Therefore, because the

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Plaintiffs are both citizens of the State of Louisiana (and no other states) for purposes of diversity jurisdiction, and none of the Defendants are citizens of the State of Louisiana, complete diversity exists among the parties.

~~15.~~17. This Court has general personal jurisdiction over Lancium because it is organized under the laws of the State of Delaware and because it maintains an ongoing presence in this District at least through its registered agent.

~~16.~~18. This Court has specific personal jurisdiction over each of Defendants McNamara and Cline at least under Title 6 of the Delaware Code, § 18-109(a).

~~17.~~19. On information and belief, Defendant McNamara is the Chief Executive Officer of Lancium. On information and belief, as the Chief Executive Offer, McNamara participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

~~18.~~20. McNamara is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from the interests of Lancium and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claims against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant McNamara together. Plaintiffs' claims against Defendant McNamara arise out of his exercise of his powers as Chief Executive Officer of Lancium.

~~19.~~21. On information and belief, Defendant Cline is the Chief Computing Officer of Lancium. On information and belief, as the Chief Computing Officer, Cline participates materially in the management of Lancium, has control and/or decision-making authority over Lancium, and is a key individual who takes actions on behalf of Lancium.

~~20.~~22. Cline is a necessary or proper party to this action because he has a legal interest in the dispute that is separate from Lancium's interest and because Plaintiffs' claims against him arise out of the same facts and occurrences as the claim against Lancium. Accordingly, it serves judicial economy to consider the claims against Lancium and Defendant Cline together. Plaintiffs' claims against Defendant Cline arise out of his exercise of his powers as Chief Computing Officer of Lancium.

~~21.~~23. The actions of Defendants McNamara and Cline establish sufficient minimum contacts with Delaware under Delaware law and the United States Constitution to give this Court personal jurisdiction over each of them.

~~22.~~24. As described below, each Defendant has committed acts giving rise to this action.

VENUE

~~23.~~25. Venue is proper in this District under 28 U.S.C. § 1391(b)(3) because there is no district in which an action may otherwise be brought as provided in § 1391(b) and Defendant Lancium is subject to the Court's personal jurisdiction with respect to this action.

PLAINTIFFS' PROPRIETARY CRYPTOCURRENCY MINING TECHNOLOGY

~~24.~~26. As of 2018, the amount of energy required to process computer algorithms to mine cryptocurrencies like Bitcoin was three times greater than the energy required to physically mine gold. Conventional mining of "copper, gold, platinum, and rare earth oxides are 4, 5, 7, and 9 megajoules to generate one U.S. dollars," while "it costs an average of 17 megajoules to mine $1 worth of bitcoin."[1] The large amount of energy required to mine cryptocurrencies can make

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[1] https://www.marketwatch.com/story/mining-bitcoin-is-3-times-more-expensive-than-mining-gold-research-paper-finds-2018-11-06

such mining financially prohibitive, and even when financially lucrative, the ~~large~~ energy ~~requirements make~~required for cryptocurrency mining can be harmful to the ~~global~~ environment, with studies showing potential carbon dioxide emissions from cryptocurrency mining "single-handedly rais[ing] global temperatures by 2 degrees by 2023." *Id*.

~~25.~~27. At the same time, some forms of electrical power generation, such as wind, solar, or other types of variable renewable energy sources, are ~~terribly~~ inefficient~~. When producers of electrical power are unable to quickly adjust their operations~~ and suffer from a timing imbalance between peak demand and energy production. Additionally, these non-dispatchable renewable energy sources cannot be controlled by operators in response to dynamically changing grid conditions~~, these producers~~. As a result, these renewable energy sources and their operators frequently sell power at low or ~~even~~ negative prices, sometimes even being curtailed or shut down entirely, until demand ~~and market prices increase~~increases and grid conditions change.

~~26.~~28. Because cryptocurrency mining using proof-of-work is a computationally demanding process, it requires a significant amount of energy to operate. As a result, industrial-scale cryptocurrency mining places a large energy burden on the power grid, driving demand and costs as well as increasing the likelihood of transmission or other grid component failure~~.~~ if not managed correctly.

~~27.~~29. In late 2018 and early 2019, Austin Storms sought to address these problems by developing energy-efficient cryptocurrency mining systems and methods that reduce the environmental impact of energy-intensive mining operations. Storms conceived of a system that better uses available energy resources to increase the stability of the energy grid, minimize a mining operation's impact on peak-demand, and help alleviate energy ~~over supply~~oversupply

and undersupply conditions, all while decreasing the overall energy costs of the mining operation and increasing its profitability.

~~28.~~30. Austin Storms conceived of and developed ~~the BearBox Technology.~~BearBox's technology. Storms is the president and founder of BearBox. ~~The BearBox Technology~~BearBox's technology includes hardware and software components. Structurally, ~~the BearBox Technology~~BearBox's technology includes a housing for a plurality of miners (such as ASICs, graphics cards, or the like) under the direction of a smart controller(s).

~~29. The smart controller monitors various external factors, such as current and expected energy demand and pricing information, current and expected cryptocurrency pricing, and the like. Based on these external factors, the system may determine whether conditions are appropriate to mine cryptocurrency and, if so, subsequently mines the cryptocurrency. Optionally, the system also includes other components for cooling, air-filtration, and related features.~~

~~30.~~31. In ~~the BearBox Technology~~BearBox's technology, a controller (such as a power distribution unit, network interface, computer, and/or the like) monitors various external factors, such as current and expected energy demand/pricing information, current and expected cryptocurrency pricing, current and expected network hashrate and difficulty, and the like. Based on these external factors, the controller(s) determines appropriate times to mine cryptocurrency in accordance with a desired performance strategy (for example, profitability thresholds). At the appropriate times, the controller initiates mining, for example, by powering on ~~the miners~~a number of miners based on various conditions internal and external conditions.

DEFENDANTS WRONGFULLY ~~CLAIM THE BEARBOX~~STOLE BEARBOX'S TECHNOLOGY ~~AS THEIR OWN~~

~~31.~~32. In May 2019, Storms attended the Fidelity FCAT Mining Summit in Boston, Massachusetts on behalf of BearBox to promote ~~the BearBox Technology~~BearBox's technology and seek potential customers for his revolutionary system.

~~32.~~33. While at the conference, Storms met Defendant McNamara. Defendant McNamara showed immediate interest in ~~the BearBox Technology.~~BearBox's technology. Under the rouse of a potential business relationship, McNamara deceptively pumped Storms for details about ~~the BearBox Technology~~BearBox's technology over the course of several exchanges, which included conversations, emails, and text messages about ~~the BearBox Technology.~~BearBox's technology. Storms took McNamara to dinner where McNamara continued to pump Storms for details about ~~the BearBox Technology. At all times before and during Storms's disclosure of this information, Storms told McNamara that the BearBox Technology was confidential, and Storms relied on McNamara's good faith assurances that he would keep confidential the information he received from Storms about the BearBox Technology~~BearBox's technology.

~~33.~~34. Following the conference, McNamara continued to press Storms for additional details about ~~the BearBox Technology~~BearBox's technology via text messaging and email. ~~Again relying on Defendant McNamara's assurances of confidentiality,~~ Storms described BearBox's technology and provided annotated system diagrams, component specifications, and modeled data sets to mimic real-world Bitcoin variables such as Bitcoin price and network hashrate, energy prices~~.~~, time intervals, and power thresholds, and computed profitability figures. Storms communications to McNamara about BearBox's technology was for the sole purpose of

potential partnership. Storms included express confidentiality notices in his email communications with Defendant McNamara.

~~34.~~35. After Storms disclosed ~~the BearBox Technology~~BearBox's technology to McNamara, McNamara abruptly ended all communications with Storms.

~~35.~~36. Storms last communicated with McNamara on May 9, 2019 via e-mail, and after sending that message, Storms did not hear from McNamara again.

~~36.~~37. At that time, Storms understood that McNamara was not interested in investing in ~~the BearBox Technology. He~~or collaborating with BearBox's technology. But Storms had no reason to suspect that ~~McNamara~~ Defendants were being deceptive and would steal ~~the BearBox Technology and claim~~BearBox's technology, including the system designs, diagrams, data, documents, and know-how, and use it ~~as his~~to build Defendants' own system that would function as BearBox's technology did.

38. In the days, weeks, and months following Plaintiffs' disclosures to McNamara, Defendants began working with partners, outside consultants, and vendors to help Defendants bring BearBox's technology to market, labeled as Defendants' own system. Defendants efforts included working internally to modify their Smart Response™ software to work as BearBox's technology did.

39. Defendants soon became confident they could exploit BearBox's technology for profit by modifying their Smart Response™ software, and then using, selling, licensing, and otherwise monetizing that modified Smart Response™ software, but Defendants also realized that others would eventually learn of Defendants' new-and-improved Smart Response™ software, now with the benefits of BearBox's technology, and may copy it in order to compete with Defendants.

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40. Defendants believed that the profits they would realize from exploiting their modified Smart Response™ software would be significantly reduced if outside competitors were allowed to copy Defendants' unauthorized use of BearBox's technology and compete directly with Defendants.

41. Because of these realizations, Defendants hatched a plan to patent some of the profitable attributes of BearBox's technology. If such a patent was obtained, Defendants believed that such a patent would effectively grant Defendants a monopoly to exploit significant portions of BearBox's technology for profits that would far exceed any profits should Defendants be left to compete with others, including BearBox.

~~37.~~42. On information and belief, Defendants filed U.S. provisional patent application No. 62/927,119 on October 28, 2019, naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

~~38.~~43. In addition to falsely claiming to be the inventors of the inventions disclosed in the application, Defendants wrongfully disclosed, without authorization, ~~the confidential BearBox Technology~~portions of BearBox's technology to the United States Patent and Trademark Office.

~~39.~~44. Likewise, on December 4, 2019, Defendants filed U.S. Patent Application Serial No. 16/702,931, once again naming Defendants McNamara and Cline as the purported sole joint inventors of the inventions disclosed in the application.

~~40.~~45. The '433 Patent issued on March 31, 2020 naming Defendants McNamara and Cline as the sole purported inventors on the face of the patent. A true and correct copy of the '433 Patent is attached hereto as Exhibit A.

~~41.~~46. The inventions claimed in the ’433 patent fall within the scope of ~~the BearBox Technology~~BearBox’s technology, yet Defendants falsely identified themselves as the inventors of the claimed inventions, when, in fact, Storms is the sole inventor of the claimed inventions. Not all aspects of BearBox’s technology that was stolen and used by Defendants was described and claimed in the ’433 Patent. For example, Defendants theft and unauthorized use included confidential aspects of BearBox technology’s system design, diagrams, data, and know-how to modify Defendants’ Smart Response software to develop and exploit, among other things, methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy values.

~~42.~~47. On information and belief, McNamara and Cline assigned their purported rights in the ’433 patent to Lancium. On information and belief, at all times, Lancium was aware that McNamara and Cline, both officers of Lancium, were not the rightful inventors of ~~the BearBox Technology~~BearBox’s technology disclosed in the patent and the inventions claimed in the patent.

~~43.~~48. Defendants McNamara and Cline each submitted signed declarations falsely swearing that they were “an original joint inventor” of the claimed subject matter~~.~~. A true and correct copy of Defendant McNamara’s and Defendant Cline’s declarations are attached as Exhibit B.

49. On June 19, 2020, Defendants announced that its Smart Response™ software allowed it to qualify as the “first successful load-only Controllable Load Resource (CLR) designation,” which Defendants described as a “breakthrough achievement,” that allows for dispatching “excess energy into the grid during times when energy is most expensive,” adding

that "with this revolutionary advancement, data centers will also be able to earn additional revenue providing ancillary services to ERCOT."

50. Since then, Defendants have used BearBox's technology, including the stolen system designs, diagrams, data, and know-how, and its subsequently-modified Smart Response™ software to function as it did, to allow Defendants to profit significantly from use, license, sale, and investments related to its modified Smart Response™ software. Defendants are not, and have never, been entitled to these profits.

51. In addition to illegally profiting from its theft and subsequent use of BearBox's technology, Defendants made use of its ill-gotten '433 patent.

~~44.~~52. On August 14, 2020, Lancium filed a lawsuit in the U.S. District Court for the Western District of Texas against Layer1 Technologies, Inc. ("Layer1") asserting that Layer1 infringes the '433 patent~~.~~, and stating that "Lancium's Controllable Load Resource Technology attracted the interest of many companies, including, upon information and belief, Layer1." That case is captioned *Lancium LLC v. Layer1 Technologies, Inc.*, Case No. 6:20-cv-739 (W.D. Texas) (the "Layer1 Lawsuit").

~~45.~~53. As part of the Layer1 Lawsuit, Defendants falsely asserted that McNamara and Cline are the sole inventors of the inventions claimed in the '433 patent.

~~46.~~54. Plaintiffs became aware of Defendants' wrongful use of ~~the BearBox Technology~~BearBox's technology on or about August 17, 2020, when they learned about the Layer1 Lawsuit through a press release dated August 14, 2020, posted by Lancium on PRNewswire. That press release is available at the following URL: https://www.prnewswire.com/news-releases/controllable-load-resource-clr-market-leader-lancium-files-patent-infringement-lawsuit-against-layer1-301112687.html.

~~47.~~55. Before seeing the August 14, 2020 press release, Plaintiffs were unaware of Defendants' wrongful use of ~~the BearBox Technology~~BearBox's technology and was unaware of the '433 patent.

~~48.~~56. On March 5, 2021, Lancium and Layer1 entered a Stipulation to Dismiss with Prejudice in the Layer1 Lawsuit. According to the stipulation, the parties had entered a Settlement Agreement to resolve the Layer1 Lawsuit.

~~49.~~57. According to a press release issued by Lancium on March 8, 2021, Lancium and Layer 1 "have entered into a mutually beneficial partnership. Layer1 has licensed Lancium's intellectual property and Lancium will provide Smart Response™ software and services to Layer1." The press release is available at the following URL: https://www.prnewswire.com/news-releases/lancium-and-layer1-settle-patent-infringement-suit-301242602.html.

~~50. On information and belief, as part of the Settlement Agreement between Lancium and Layer1 to settle the Layer1 Lawsuit, Lancium received and continues to receive valuable consideration from Layer1, all of which rightly belongs to Plaintiffs, the rightful owners of the inventions claimed in the '433 Patent.~~

COUNT I
CORRECTION OF INVENTORSHIP FOR THE '433 PATENT:
AUSTIN STORMS AS SOLE INVENTOR

~~51.~~58. Plaintiffs incorporate the above paragraphs by reference.

~~52.~~59. Storms is the sole inventor of the subject matter claimed in the '433 Patent.

~~53.~~60. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the '433 patent and the currently listed inventors on the '433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms or BearBox.

~~54.~~61. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the ’433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT II
IN THE ALTERNATIVE, CORRECTION OF INVENTORSHIP FOR THE ’433 PATENT: AUSTIN STORMS AS JOINT INVENTOR WITH THE CURRENTLY NAMED INVENTORS

~~55.~~62. Plaintiffs incorporates the above paragraphs by reference.

~~56.~~63. In the alternative, Storms is a joint inventor of the subject matter claimed in the ’433 Patent and should be added to the individuals currently named as inventors on the ’433 Patent.

~~57.~~64. Through omission, inadvertence, and/or error, Storms was not listed as an inventor on the ’433 patent and the currently listed inventors on the ’433 patent were improperly listed. The omission, inadvertence, and/or error occurred without any deceptive intent on the part of Storms.

~~58.~~65. Unless Defendants Lancium, McNamara, and Cline are enjoined from asserting that McNamara and Cline are the sole inventors of the ’433 Patent in violation of U.S. federal patent laws, Plaintiffs will suffer irreparable injury. Plaintiffs have no adequate remedy at law.

COUNT III
TRADE SECRET MISAPPROPRIATION UNDER FEDERAL DEFEND TRADE SECRETS ACT, 18 U.S.C. § 1836

66. Plaintiffs incorporate the above paragraphs by reference.

67. ~~COUNT III~~At all relevant times, Plaintiffs and Defendants were engaged in interstate commerce. For example, Plaintiffs and Defendants are engaged in trade and business,

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developing and testing, among other things, cryptocurrency mining systems and related methods in interstate commerce throughout the United States.

68. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about BearBox's technology relating to certain features, including methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy values. Such information constitutes trade secrets of substantial economic value, at least because methods for energy value arbitrage may be used for substantial profit. This confidential technical information was not known to the public or to other persons who can obtain economic value from its disclosure or use. This information constituted a trade secret under the Defend Trade Secrets Act, 18 U.S.C. §§ 1836.

69. Defendants knew the information they received from Austin Storms about BearBox's technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship, and was in no way the information received to be used by Defendants' for their own profit. McNamara himself referred to the exchanges with Plaintiffs' "lots of stuff to collaborate on." Defendants further knew the technical information they received from Storms about BearBox's technology was confidential based upon Defendants' own actions taken to protect that information once they possessed it, and misappropriated it by using in modification of their Smart Response™ software. Defendants' restricted access to the information, including as it was represented in the Smart Response™ software, required confidentiality agreements for third party customers, potential customers, and licensees, and other internal measures were taken.

70. Plaintiffs included a confidentiality designation on communications to which the confidential trade secret information was attached. Plaintiffs took additional reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of individuals that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its computers. The confidential information was, at all other times, secured on a password protected computer. The confidential information was not externally accessible through the internet. When that password protected computer was not attended, it was secured in a locked building at Storms residence, which included other security measures such as a concierge and elevator keys.

71. For the very limited number of additional occasions the confidential, trade secret information was shared, it was shared with a person or entity subject to contractual obligations regarding confidentiality and/or prohibitions on unauthorized use. For the limited number of occasions BearBox shared the confidential, trade secret information with potential customers, it was done only with BearBox management approval.

72. Defendants misappropriated Plaintiffs' trade secrets when they used BearBox technology, without Plaintiffs' authorization, in at least its Smart Response™ software. Defendants have disclosed and/or used the confidential information without the express or implied consent of Plaintiffs. The acts of taking Plaintiffs' confidential information, and using it as Defendants' own, and without permission was improper. Further, Defendant McNamara agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.

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73. As a result of Defendants' misappropriation of Plaintiffs' trade secrets, Plaintiffs' have suffered and will suffer damages or other financial harm in an amount to be proven at trial including, but not limited to, damages for actual loss caused by the misappropriation of the trade secrets, financial loss for any unjust enrichment caused by the misappropriation of the trade secrets, and/or damages caused by the misappropriation measured by imposition of liability.

74. The Defendants willfully and maliciously misappropriated the Plaintiffs' trade secrets, and Plaintiffs are therefore entitled to an award of exemplary damages and an award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(C), (D).

COUNT IV
TRADE SECRET MISAPPROPRIATION UNDER LOUSIANA CIVIL PRACTICE AND REMEDIES CODE, TITLE 51, SECTION 13-A

75. Plaintiffs incorporate the above paragraphs by reference.

76. At all relevant times, Plaintiffs and Defendants were engaged in trade or commerce within the meaning of La. R.S. 51:1431-39 (2011), the Louisiana Uniform Trade Secrets Act. For example, Plaintiffs and Defendants are engaged in trade and business, developing and testing, among other things, cryptocurrency mining systems and related methods.

77. In the course of the interactions between Austin Storms and Defendants, Defendants obtained confidential information about BearBox's technology relating to certain features, such as methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy values. Such information constitutes trade secrets of substantial economic value, at least because methods for energy value arbitrage, including cryptocurrency mining systems and arbitraging related energy valuesmay be used for substantial profit. This confidential technical information was not known to the public or to other persons who can

obtain economic value from its disclosure or use. This information constituted a trade secret under the Louisiana Uniform Trade Secret Act.

78. Defendants knew the technical information they received from Austin Storms about BearBox's technology was confidential, as Storms specifically informed Defendant McNamara that the information given to him was to be held in confidence, and was not to be used for any other purpose beyond those necessary to carry out an evaluation in advance of a potential business relationship, and was in no way the information received to be used by Defendants' for their own profit. Defendants further knew the information they received from Storms about BearBox's technology was confidential based upon Defendants' own actions taken to protect that information once they possessed it. Defendants' restricted access to the information, required confidentiality agreements for third party customers, potential customers, and licensees, and other internal measures were taken. Defendants further took these actions to protect Plaintiffs' confidential information after Defendants misappropriated it by including it for use in Defendants' Smart Response™ software.

79. Plaintiffs included a confidentiality designation on communications to which the confidential trade secret information was attached. Plaintiffs took additional reasonable steps to preserve secrecy via these explicit guidelines regarding confidentiality and by limiting the number of collaborators that Plaintiffs allowed to access this information. Plaintiffs also had systems in place to maintain confidentiality with respect to third parties, by, for example, limiting access to its computers. The confidential information was, at all other times, secured on a password protected computer. The confidential information was not externally accessible through the internet. When that password protected computer was not attended, it was secured in a locked building.

80. For the very limited number of additional occasions the confidential, trade secret information was shared, it was shared with a person or entity subject to contractual obligations regarding confidentiality and/or prohibitions on unauthorized use. For the limited number of occasions BearBox shared the confidential, trade secret information with potential customers, it was done only with BearBox management approval.

81. Defendants misappropriated Plaintiffs' trade secrets when they used BearBox technology, without Plaintiffs' authorization, in at least its Smart Response™ software. Defendants have disclosed and/or used the confidential technical information without the express or implied consent of Plaintiffs. The acts of taking Plaintiffs' confidential information, and using it as Defendants' own, and without permission was improper. Further, Defendant McNamara agreed to abide by Plaintiffs' confidentiality terms, only to violate these terms in secret. Defendant McNamara's deception led to Storms continuing to disclose confidential information to Defendants.

82. As a result of Defendants' misappropriation of Plaintiffs' trade secrets, Plaintiffs' have suffered and will suffer damages or other financial harm in an amount to be proven at trial including, but not limited to, damages for actual loss caused by the misappropriation of the trade secrets, financial loss for any unjust enrichment caused by the misappropriation of the trade secrets, and/or damages caused by the misappropriation measured by imposition of liability.

83. The Defendants willfully and maliciously misappropriated the Plaintiffs' trade secrets, and Plaintiffs are therefore entitled to an award of exemplary damages and an award of reasonable attorney's fees under § 51:1434.

COUNT V
CONVERSION BY LANCIUM, MCNAMARA, AND CLINE

~~59.~~84. Plaintiffs incorporates the above paragraphs by reference.

~~60.~~85. Austin Storms, in his capacity as founder and President of BearBox, conceived, developed, and reduced to practice ~~the BearBox Technology.~~BearBox's technology. Plaintiffs own ~~the BearBox Technology, related~~ BearBox's technology, including system designs, documents, data, and know-how~~, and related intellectual property.~~. Plaintiffs owned this property during all relevant time periods in this suit. ~~Information on the BearBox Technology was provided to Defendants solely for the purposes of evaluation for a potential business relationship and under strict confidentiality obligations.~~

86. Defendants induced Plaintiffs to provide information and documents regarding BearBox's technology to Defendants by misrepresenting that Defendants were interested in investing in or otherwise collaborating with BearBox. Information and documents regarding BearBox's technology were provided to Defendants solely for the purposes of evaluation for a potential business relationship.

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87. Without Plaintiffs' consent, Defendants intentionally and willfully assumed dominion and control over ~~the BearBox Technology by claiming~~BearBox's technology, including system designs, documents, data, and know-how, and improperly used it ~~as~~to modify their ~~own in~~ Smart Response™ software, and corresponding system designs, to function as reflected in BearBox's system designs, documents, data, and know-how, and subsequently used, sold, licensed, and procured investments related to, and otherwise monetized, that software for substantial profit.

88. Defendants' unlawful exercise of dominion over confidential Bearbox technology, including system designs, documents, data, and know-how not otherwise found to be a trade secret, or having value beyond the ~~'433 patent. Through~~value of the trade secret(s), has permanently interfered with Plaintiffs' valuable property rights.

~~61.~~89. Despite providing Defendants with the system designs, documents, data, and know-how that allowed Defendants to modify their ~~wrongful conduct in obtaining the '433 Patent and claiming the BearBox Technology as their own, the~~ Smart Response™ software, and corresponding system designs, Defendants have ~~wrongfully obtained the purported ability to exclude Plaintiffs and others from using the BearBox Technology. This constitutes~~not compensated or recognized Plaintiffs for the use of BearBox's technology. Defendants' actions constitute an improper and unauthorized ~~and unlawful conversion by Defendants~~use of Plaintiffs' property.

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~~62.~~90. As a result of Defendants' ~~wrongful actions, Plaintiffs~~ improper and unauthorized use of Plaintiffs' system designs, documents, data, and know-how to reconstruct and use Bearbox's technology, Plaintiffs have suffered and will continue to suffer ~~imminent and irreparable~~ damages and other financial harms in an amount to be proven at trial. ~~In particular, Plaintiffs have been damaged by losing valuable intellectual property from which~~As such, Plaintiffs ~~would have derived substantial revenue via licensing and/or selling patented products~~are entitled to damages resulting from Defendants' improper and unauthorized use.

COUNT ~~IV~~VI
UNJUST ENRICHMENT BY LANCIUM, MCNAMARA, AND CLINE

91. Plaintiffs incorporate the above paragraphs by reference.

~~63.1. Plaintiffs incorporate the above paragraphs by reference.~~

~~64.~~92. Plaintiffs conferred a benefit on Defendants by providing them valuable ~~intellectual property about cryptocurrency mining systems and related confidential information and materials under the boundaries of a potential collaboration between BearBox and Lancium~~technology, specifically BearBox's technology, including system designs, documents, data, and know-how.

~~65.~~93. ~~Defendants accepted that cryptocurrency mining intellectual property and, indeed, continuously asked~~Defendants pressed Storms to provide more information and materials, having recognized the benefit that Defendants received by having access to ~~the BearBox Technology~~system designs, documents, data, and know-how reflecting BearBox's technology.

94. Defendants ~~accepted~~induced Plaintiffs to provide these system designs, documents, data, and know-how by misrepresenting that Defendants were interested in investing in or otherwise collaborating with Bearbox. Defendants' actions in obtaining Plaintiffs' system designs, documents, data, and know-how were deceptive.

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~~66.~~95. Defendants retained ~~the BearBox Technology~~BearBox's technology, including system designs, documents, data, and know-how, and used it to their own advantage, and at ~~Plaintiffs'~~BearBox's expense.

~~67.~~96. Defendants have been and continue to be unjustly enriched by profiting from their wrongful conduct. ~~In particular~~For example, without Plaintiffs' consent, Defendants ~~have unlawfully~~ used Plaintiffs' ~~property by asserting inventorship over the BearBox Technology~~system designs, documents, data, and know-how to modify their Smart Response™ software to function as BearBox's technology did. As a result, Defendants are deriving an unjust benefit from exploiting ~~Storms's cryptocurrency mining inventions. It would be inequitable for Defendants to retain these benefits under these circumstances.~~BearBox's property.

97. Despite providing Defendants with the system designs, documents, data, and know-how that allowed Defendants to modify their system designs and Smart Response™ software to function as BearBox's technology did, Defendants have not compensated Plaintiffs for the use of BearBox's technology. It would be inequitable for Defendants to retain these benefits under these circumstances.

98. Defendants' unauthorized use of Bearbox's technology has impoverished Plaintiffs by depriving them of the fruits of their labor. In addition to the costs incurred and labor expended in creating Bearbox's technology, Plaintiffs are no longer able to obtain any economic benefit from any use of Bearbox's technology.

99. Defendants' enrichment through the use of Plaintiffs' system designs, documents, data, and know-how to reconstruct and use Bearbox's technology is directly connected to Plaintiffs' impoverishment because Defendants have failed to compensate Plaintiffs for their efforts.

100. There is no justification at law or in contract for Defendants' uncompensated use of Plaintiffs' unique and novel invention.

~~68.~~101. Because Plaintiffs have incurred, and continue to incur, detriment in the form of loss of money and property as a result of Defendants' wrongful use of ~~Plaintiffs' intellectual property, including the right to any patent based on their own intellectual property. The intellectual property, including the right to any patents based on Plaintiffs' intellectual property and to any patent documents (including assignment documents), U.S. and foreign, are unique and there is no adequate remedy at law~~system designs, documents, data, and know-how reflecting BearBox's technology, Plaintiffs are entitled to compensation to the extent Defendants have been enriched or Plaintiffs have been impoverished.

~~69. The harm to Plaintiffs is continuous, substantial, and irreparable.~~

~~COUNT V~~
~~NEGLIGENT MISREPRESENTATION BY LANCIUM AND MCNAMARA~~

~~70.~~1. ~~Plaintiffs incorporate the above paragraphs by reference.~~

~~71. In connection with the potential work involving cryptocurrency mining systems and related methods, Storms told Defendant McNamara that the cryptocurrency mining systems~~

~~and related methods were proprietary to Plaintiffs and not to be used or shared outside of Lancium. Defendant McNamara gave his word that he would abide by this confidentiality. On information and belief, Defendant McNamara agreed to keep the BearBox Technology confidential despite later recklessly incorporating the BearBox Technology into his own patent applications and swearing, as recently as December 4, 2019, that he is an inventor of the BearBox Technology. Storms relied on Defendant McNamara's assurances of confidentiality and continued to share details about the BearBox Technology with Defendants.~~

~~72. If Plaintiffs had known that Defendants would secretly incorporate the BearBox Technology into Defendants' own patent applications to claim them as Defendants' intellectual property, Plaintiffs would not have continued working with and sharing intellectual property with Defendants.~~

~~73. Plaintiffs suffered a pecuniary loss based on this reliance including the loss of potential patent rights, and the costs of Plaintiffs' know-how converted under the guise of a potential business relationship.~~

JURY DEMAND

~~74.~~102. Under Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiffs respectfully demand a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, BearBox respectfully requests the following relief:

A. An order that the Director of the United States Patent and Trademark Office correct the inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

B. Alternatively, an order that Defendants sign the requisite documents to correct inventorship of the '433 Patent to name Austin Storms as the sole inventor, or, in the alternative, as a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

C. A declaration that Austin Storms is the sole inventor, or, in the alternative, is a joint inventor to one or both of the individuals currently listed as inventors on the '433 Patent;

D. A preliminary and a permanent injunction enjoining Defendants Lancium, McNamara, and Cline from asserting that McNamara or Cline are inventors of the '433 Patent in violation of the United States federal patent laws;

E. An order that Defendants immediately transfer to Plaintiffs all right, title, and interest in all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of ~~Plaintiffs' intellectual property~~BearBox's technology;

F. An order for a constructive trust over all information, patent applications, patents, technology, products, and other materials in the possession, custody, or control of Defendants that wrongfully constitute, contain, were based on, and/or derived in whole or in part from the use of ~~Plaintiffs' intellectual property;~~ BearBox's technology or any system designs, documents, data, and know-how reflecting BearBox's technology;

G. Financial relief including damages, consequential damages, disgorgement of Defendants' ill-gotten profits, Defendants' unjust enrichment, ~~reasonable royalty damages, lost profits damages,~~ reliance damages, and/or all other appropriate financial relief, all in an amount to be determined at trial, with interest;

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H. An award of the amount by which Defendants have been unjustly enriched by their actions set forth in this Complaint ~~and their purported ownership of patents covering Plaintiffs' intellectual property~~;

I. A finding that this is an exceptional case warranting imposition of attorney fees against Defendants and an award to Plaintiffs of its reasonable costs and attorney fees incurred in bringing this action pursuant to 35 U.S.C. § 285; ~~and~~

J. An award of exemplary damages and/or an award of reasonable attorney's fees under 18 U.S.C. § 1836(b)(3)(C), (D) and/or under La. R.S. § 51:1434; and

~~J.~~K. An award of such further relief at law or in equity, such as preliminary and/or permanent injunctive relief, as the Court deems just and proper.

ASHBY & GEDDES

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